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Alberta Heavy Oil, Oil Sands and Enhanced Recovery

**Experimental Pilot Projects
February, 1992**

Alberta

OIL SANDS TECHNOLOGY
AND RESEARCH AUTHORITY

Alberta Heavy Oil, Oil Sands and Enhanced Recovery

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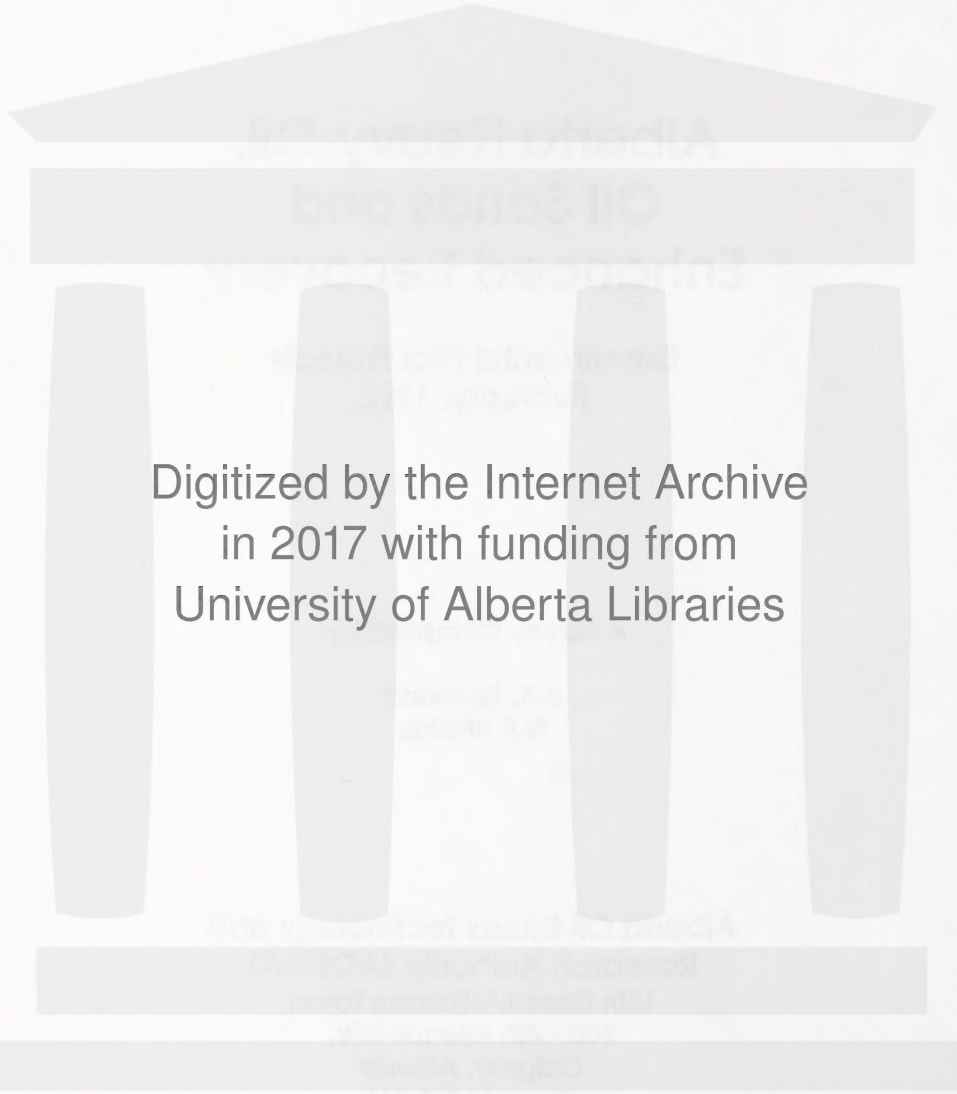
A Survey Compiled by:

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PILOT PROJECTS IN ALBERTA

Currently Operating February, 1992

Summary

The 1992 survey provides detailed coverage of all of Alberta's seventy-nine active or recently terminated in situ heavy oil, oil sands and enhanced oil recovery pilot projects. Each pilot project listed contains the following information:

- a detailed reservoir description
- a detailed field facilities description
- well pattern
- project-specific description of EOR process employed
- historical documentation of the engineering events associated with the project
- description of important adjustments made to improve the process performance.

AOSTRA participates in 22 of the projects and operates the Underground Test Facility.

Acknowledgements

AOSTRA gratefully acknowledges the cooperation of all the operators who provided the information contained in this survey.

If you have any comments on how the survey can be improved, please contact AOSTRA/Calgary at (403) 297-3380.

PILOT PROJECTS IN ALBERTA

Currently Operating February, 1992

Operator

Sector

Alberta Energy Company Ltd.

Suffield Horizontal Well
Suffield Horizontal Well #2

Alberta Oil Sands Technology
and Research Authority

Athabasca*

Amoco Canada Petroleum
Company Ltd.

Brintnell
Cessford*
David
Drumheller Horizontal Well (New)
Morgan

BP Canada Inc.

Chauvin South Sparky 'E'

Bumper Development
Corporation Ltd.

Twining Rundle 'A' Pool*

Cabre Exploration Ltd.

Carrot Creek Horizontal Well

Canada Northwest Energy Ltd.

Atlee Buffalo

Canadian Hunter Exploration
Ltd.

Swan Hills Beaverhill Lake*

Chevron Canada Resources Ltd.

Steepbank HASDrive
Taber

Cimarron Petroleum Ltd.

Del Bonita Rundle Pool*

Esso Resources Canada Ltd.

Fisher Creek
Leming
May/Ethel
Rainbow
Redwater

Gulf Canada Resources Ltd.

Fenn-Big Valley*

Home Oil Company Ltd.

Kitscoty

Husky Oil

Caribou Lake (New)

Koch Exploration Canada Ltd.

Fort Kent

Mazzei Oil & Gas Ltd.

Frog Lake (New)

Mobil Oil Canada, Ltd.

Iron River
Muskeg River+

Norcen Energy Resources Ltd.

Boyer Horizontal Well 1
Boyer Horizontal Well 2
Lindbergh I
Lloydminster Horizontal Well (New)
Provost (Bodo)*
Countess B*

PanCanadian Petroleum Ltd.

PCEJ

Petro-Canada Resources

Leduc Woodbend

Pinnacle Resources

Horizontal Well

Renaissance Energy Ltd.

Horizontal Well

Rife Resources Ltd.

Grand Forks Horizontal Well

Sceptre Resources Limited

Horizontal Well

Total Petroleum Canada Ltd.

Joffre II*

Vikor Resources Ltd.

*AOSTRA Participation
+Coal Bed Methane

APPENDIX

Recently Terminated Pilot Projects

Operator	Sector
Alberta Energy Company Ltd.	Ipiatik Lake Phase A Ipiatik Lake Phase B Suffield I* Suffield II* Suffield Hot Water Flood*
Amoco Canada Petroleum Company Ltd.	Atlee Buffalo Gregoire Lake Phase A* Gregoire Lake Phase B* Soars Lake (Beaverdam) Soars Lake (Beaverdam) (II)
Bow Valley Industries Ltd.	Marie (Cold Lake)*
BP Canada Inc.	Marguerite Lake* (Petro-Canada 50%) Project Owl
Canadian Occidental Petroleum Ltd.	Manatokan Morgan
Claude Beau Canada Petroleum Ltd.	Twining Rundle Pool*
CS Resources Ltd.	Pelican
Esso Resources Canada Ltd.	Leduc
Excel Energy Inc.	Ardmore
Gulf Canada Resources Ltd.	Fenn-Big Valley*
Husky Oil	Kearl Lake*
Mazzei Oil & Gas Ltd.	Frog Lake*
Mobil Oil Canada, Ltd.	Kitscoty Wolf Lake Wolf Lake Extension
Murphy Oil Company Ltd.	Lindbergh Morgan
Norcen Energy Resources Ltd.	Lindbergh II Lindbergh III
PanCanadian Petroleum Ltd.	Lindbergh Lindbergh - Elk Point

Petro-Canada Resources

Coal Bed Methane+
Hangingstone I
Hangingstone II
Hangingstone III
Provost Dina
Viking-Kinsella B*

Signalta Resources Ltd.

Pembina-Lobstick

Ulster Petroleum Ltd.

Retlaw* (Applied for Commercial Project Status)

Vikor Resources Ltd.

Joffre I*

*AOSTRA Participation
+Coal Bed Methane

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Alberta Energy Company

Suffield Horizontal Well

LOCATION

LSD: 5I Section: 34 Township: 19 Range: 8 W4M

PARTNERS:

Alberta Energy Company Limited	70%
Westcoast Petroleum Ltd.	30%

PROCESS: Horizontal Well

START-UP: October 1987

TERMINATION: In Progress

DESCRIPTION

PILOT AREA: Single well test

WELL PATTERN: Horizontal section extends 251 metres in oil pay.

NO. OF WELLS: one

FACILITIES

ARTIFICIAL LIFT METHODS: Conventional Beam Pumpjack

TRANSPORT: Pipeline

RESERVOIR

Geological Horizon: Glauconite Sandstone

Depth to Top of Formation: 938 m.KB

Reservoir Thickness:

net: 15 m

gross: 18 m

Original Temperature: 30°C

Original Pressure: 10000 kPa

Average Horizontal Permeability: 1000 md

Average Porosity: 25%

Average Water Saturation S_w 25% pore vol.

Average Oil Saturation S_o 75% pore vol.

Oil Viscosity at Reservoir Temp. 395 mPa.s

Oil Gravity at Reservoir Temp 970-975 Kg/m³

Source: Pilot Operator

Alberta Energy Company

Suffield Horizontal Well #2

LOCATION

LSD: 6D Section: 3 Township: 20 Range: 8 W4M

PARTNERS:

Alberta Energy Company Limited	70%
Westcoast Petroleum Ltd.	30%

PROCESS: Horizontal Well

START-UP: February 1988

TERMINATION: In Progress

DESCRIPTION

PILOT AREA: Single well test

WELL PATTERN: Horizontal section extends 655 metres in oil pay.

NO. OF WELLS: one

FACILITIES

ARTIFICIAL LIFT METHODS: Conventional Beam Pumpjack

TRANSPORT: Pipeline

RESERVOIR

Geological Horizon: Glauconite Sandstone

Depth to Top of Formation: 938 m.KB

Reservoir Thickness:
net: 8 m

Original Temperature: 30°C

Original Pressure: 10000 kPa

Average Horizontal Permeability: 1000 md

Average Porosity: 25%

Average Water Saturation S_w 25% pore vol.

Average Oil Saturation S_o 75% pore vol.

Oil Viscosity at Reservoir Temp. 395 mPa.s

Oil Gravity at Reservoir Temp. 970-975 Kg/m³

Source: Pilot Operator

AOSTRA

Underground Test Facility

LOCATION

LSD: 2,3,14 & 15 Section: 7,18 Township: 93
Range: 12 W4M

PARTNERS:

Access Stage - 100% AOSTRA

Phase B Process Test

- AOSTRA
- Amoco Canada Petroleum Company Ltd.
- Chevron Canada Resources Limited
- Mobil Oil Canada
- Petro-Canada Inc.
- Shell Canada Limited
- Esso Resources Canada Ltd.
- Conoco Canada Ltd.
- Japex Oil Sands Ltd.

PROCESS: Shaft & Tunnel Access to Horizontal Well Drilling.

Horizontal Well Processes:

Steam-Assisted Gravity Drainage (SAGD)

COST: Capital: \$150,000,000 to 1996

START-UP:

Mine Access: September 1986

Phase A Processes: November 1987

Phase B Processes: October 1991

TERMINATION:

Phase A 1990; Phase B1 1994; Phase B2 1996

DESCRIPTION

PILOT AREA:

Phase A: 1.0 ha

HASDrive: 0.3 ha

Phase B: 11 ha

Lease: 20,000 ha

WELL PATTERN:

Phase B: 3 pairs of horizontal wells; 600 m length; end 500 m completed

WELL SPACING:

75 m between wellpairs

OBSERVATION WELLS:

Phase B: 30 wells containing a mix of temperature and geotechnical instrumentation.

FACILITIES

MINE ACCESS:

Two 3-4 m I.D. access shafts 213 m deep; 1500 m of tunnel, 5 m wide x 4 m high cross-section; high speed hoist in #1 shaft

PROCESS:

One 7,000,000 BTU/hr, one 25,000,000 BTU/hr, and one 50,000,000 BTU/hr. steam generator; pumping or steam lift if required; simple gas separation & shipment of produced fluids. Full separation facility by September 1992 for 2000 BPD fluids.

RESERVOIR

Geological Horizon: McMurray

Depth to Top of Formation: 135 m.KB

Reservoir Thickness:
net: 22 m

Original Temperature: 7°C

Original Pressure: 450 kPa

Average Horizontal Permeability: 5000 md

Average Porosity: 35%

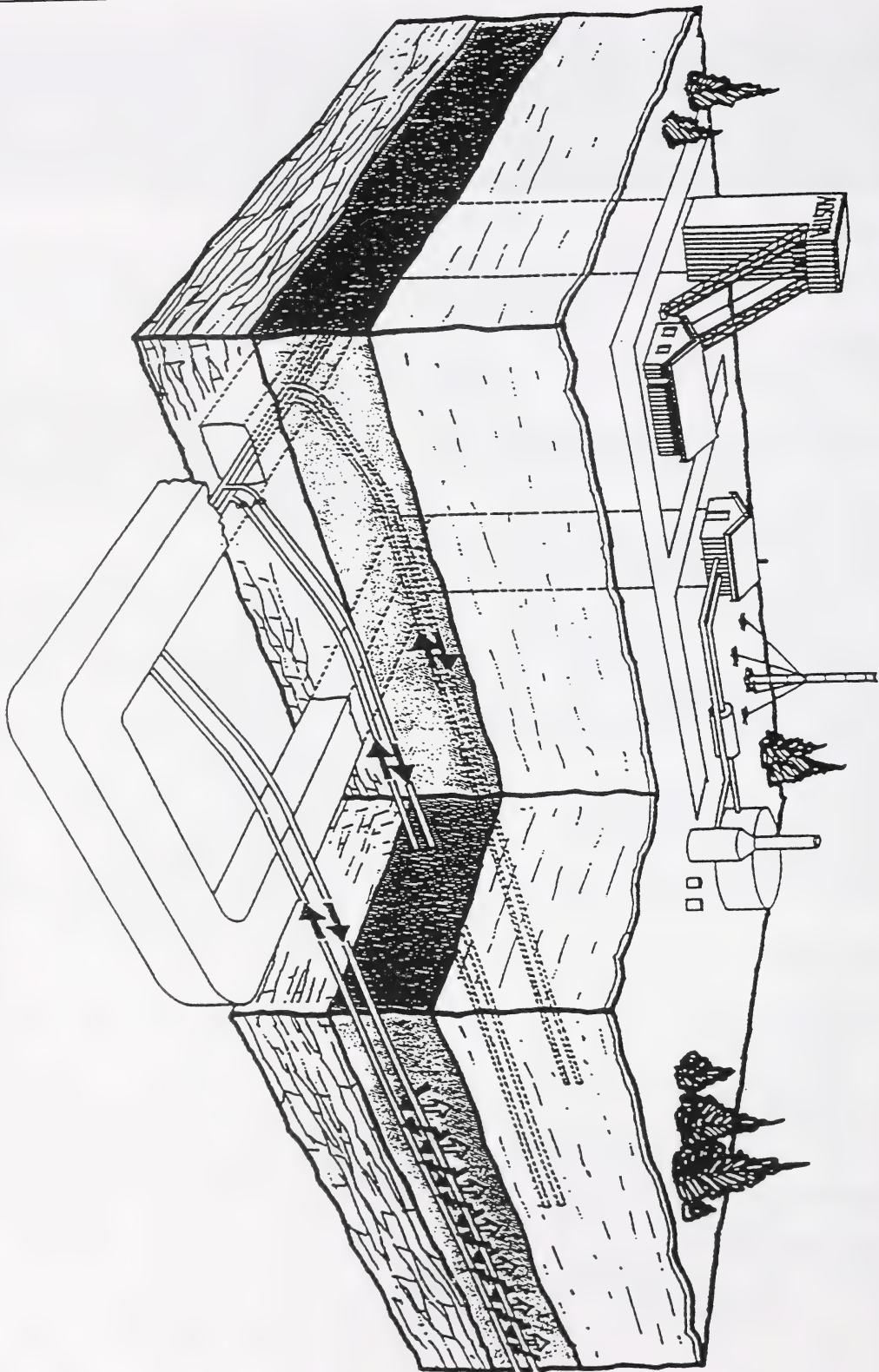
Average Water Saturation S_w : 20%

Average Oil Saturation S_o : 80% pore vol.

Oil Viscosity at Reservoir Temp. 5,000,000 mPa.s

Oil Gravity at Reservoir Temp. 1014 Kg/m³

Source: AOSTRA



UNDERGROUND TEST FACILITY

Amoco Canada Petroleum Company Ltd.

Brintnell

LOCATION

LSD: 6 Section: 24 Township: 81 Range: 23 W4M
LSD: 10 Section: 15 Township: 81 Range: 23 W4M
LSD: 5 Section: 1 Township: 81 Range: 23W4M
LSD: 7 Section: 23 Township: 80 Range: 23W4M
LSD: 5 Section: 24 Township: 80 Range: 23W4M

PARTNERS:

Amoco Canada Petroleum Company Ltd. 100%

PROCESS: Steam Stimulation

START-UP: November 1985

TERMINATION: March 1986 (reactivated in 1988)
Experimental status expired
Jan. 1, 1992

DESCRIPTION

Single Well Cyclic Steam Stimulation Program

WELL SPACING: 64.75 ha

NO. OF WELLS:

Injection/Production 25

FACILITIES

STEAM GENERATOR(S): one - 22 GJ/hr steam generator - portable

ARTIFICIAL LIFT METHODS: Beam Pump and Progressive Cavity Pumps

STORAGE FACILITIES: 120 m³ Tanks

RESERVOIR

Geological Horizon:	Wabiskaw
Depth to Top of Formation:	425 m.KB
Reservoir Thickness:	
net:	7 m
gross:	15 m
Original Temperature:	28°C
Original Pressure:	2700 kPa
Average Porosity:	28%
Average Water Saturation S_w	35%
Average Oil Saturation S_o	65% pore vol.
Oil Viscosity at Reservoir Temp.	360 mPa.s
Oil Gravity at Reservoir Temp.	940 Kg/m ³
Primary Production Rates:	3 m ³ /well/day
Source:	Pilot Operator

COMMENTS

This project was suspended in March, 1986 due to low heavy oil prices and reactivated in 1988. Two horizontal wells were drilled in 1988.

Two electromagnetic wells were drilled in 1990. Two additional horizontal wells were drilled in late 1990.

As of January 1, 1992 the Brintnell project is no longer experimental.

Amoco Canada Petroleum Company Ltd.

Cessford

LOCATION

Section: 34,27,23,11,10,3 Township: 25
Range: 12 W4M

PARTNERS:

Initial Phase:
Amoco Canada Petroleum Company Ltd. 54.1%
Esso 49.9%

Incremental Phase:
AOSTRA 50.0%
Amoco Canada Petroleum
Company Ltd. 27.05%
Sulpetro 22.95%

PROCESS: Caustic Polymer Flood

COST: Capital - 2,500,000
Operating - \$1,700,000/year

START-UP: Waterflooding in 1981, caustic flooding in July 1984, polymer flooding in January 1985. Polymer injection terminated prematurely in January 1990 due to low injectivity. Continuing production under conventional waterflood.

TERMINATION: November 1992

DESCRIPTION

PILOT AREA: 260 ha

WELL PATTERN: Five 5-Spots and two line drive

WELL SPACING: 32 ha

NO. OF WELLS:

Injection	7
Production	19
Observation	0

FACILITIES

Water ion - exchange softeners with individual pumping units.

ARTIFICIAL LIFT METHODS: Conventional Beam Pumps

STORAGE FACILITIES: Tanks

TRANSPORT: Pipeline

RESERVOIR

Geological Horizon: Basal Colorado A Sandstone
Depth to Top of Formation: 884-905 m.KB
Reservoir Thickness:

net:	4 m
gross:	4 m

Original Temperature: 30°C

Original Pressure: 8720 kPa

Average Horizontal Permeability: 200-400 md

Average Porosity: 24%

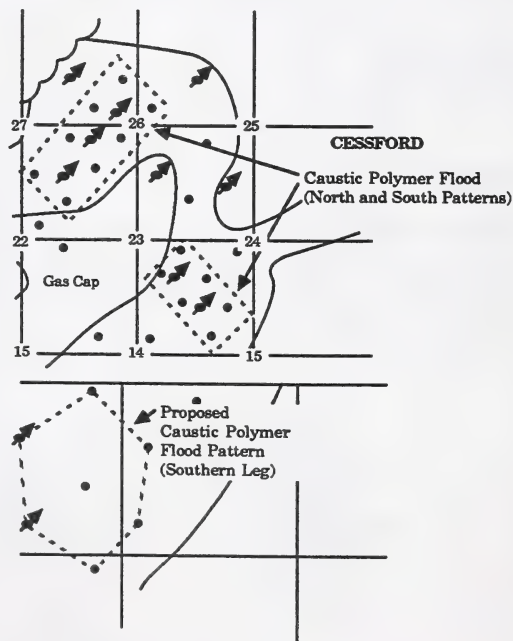
Average Water Saturation S_w 30%

Average Oil Saturation S_o 70% pore vol.

Oil Viscosity at Reservoir Temp. 24 mPa.s

Oil Gravity at Reservoir Temp. 912 Kg/m³

Source: Pilot Operator



Amoco Canada Petroleum Company Ltd.

David

LOCATION

Section: 2&11 Township: 41 Range: 3 W4M

PARTNERS:

Amoco Canada Petroleum Company Ltd. 49%
Encor 24.75%

PROCESS: Alkaline Polymer Injection

START-UP: 1986

TERMINATION: 1992

COMMENTS: The project completed the target pore volume slug of alkali/polymer in December, 1990. The tapered polymer slug has been completed as of January 1992. Fresh water injection is continuing.

Primary production period 1969 to 1978

Waterflood 1978 to 1986

Tertiary (alkali/polymer) 1986 to 1992

DESCRIPTION

PILOT AREA: 99 ha

WELL PATTERN: Irregular

WELL SPACING: 8 & 4 ha

NO. OF WELLS:

Injection

Production

Observation

7
21
0

FACILITIES

ARTIFICIAL LIFT METHODS: Pumps

TREATER TYPE: Pressure Treaters

STORAGE FACILITIES: Tanks

TRANSPORT: Pipeline

RESERVOIR

Geological Horizon:

Depth to Top of Formation:

Reservoir Thickness:

net:

Original Temperature:

Original Pressure:

Average Horizontal Permeability:

Average Porosity:

Average Water Saturation S_w

Average Oil Saturation S_o

Oil Viscosity at Reservoir Temp.

Oil Gravity at Reservoir Temp.

Primary Production Rates:

Source:

Lloydminster

760 m.KB

3.2 m

30.6°C

5580 kPa

1480 md

29%

27%

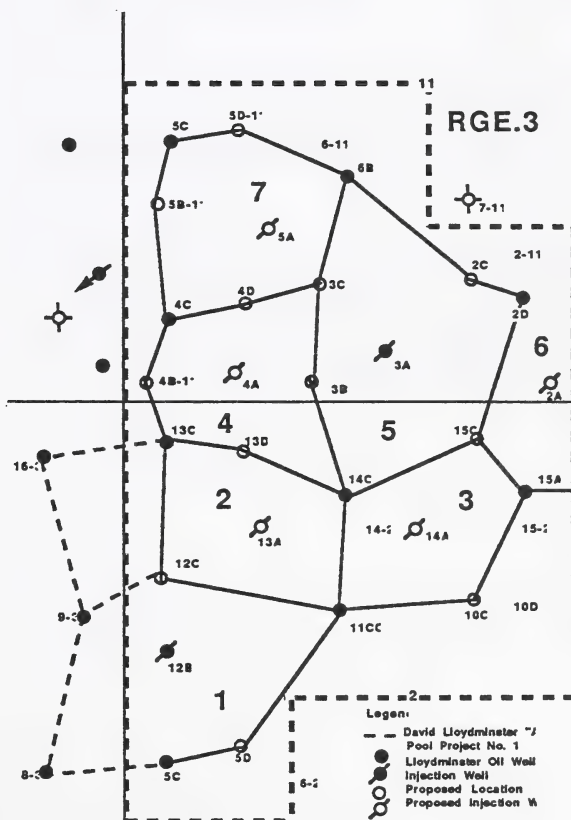
73% pore vol.

34.2 mPa.s

918 Kg/m³

12 m³/well/day

Pilot Operator



Amoco Canada Petroleum Company Ltd.

Drumheller Horizontal Well

LOCATION

LSD: 14 Section: 13 Township: 29 Range: 20 W4M

PARTNERS:

Amoco Canada Petroleum Company Ltd.
Norcen Energy Resources Ltd.
Okanagan Petroleums Ltd.
Twin Richfield Ltd.
Voyager Energy Co.
N.L. Easley
S. Whipple

PROCESS: Short Radius Horizontal Well

COST: \$936,000

START-UP: January 15, 1988

TERMINATION: Rig Release February 18, 1988; On Stream March 10, 1988

DESCRIPTION

WELL SPACING: 80 acre in Sec. 13

NO. OF WELLS:

1 horizontal well drilled

FACILITIES

ARTIFICIAL LIFT METHODS: Reda Submersible Pump

RESERVOIR

Geological Horizon:	Nisku/Dolomite
Depth to Top of Form.:	Porosity top~ 830 ASL
Reservoir Thickness:	
net:	5 m
gross:	30 m
Original Temperature:	56°C
Original Pressure:	13,338 kPa
Average Horizontal Permeability:	40 md
Average Porosity:	7.5%
Average Water Saturation S_w	20%
Average Oil Saturation S_o	80% pore vol.
Oil Viscosity at Reservoir Temp.	1.3 mPa.s
Oil Gravity at Reservoir Temp.	850 Kg/m ³
Source:	Pilot Operator

COMMENTS: Extremely high water oil ratios are being encountered and the operation is being reviewed to determine the suitability of continuing.

Amoco Canada Petroleum Company Ltd.

Morgan

LOCATION

LSD: 35 Section: 35 Township: 51 Range: 4 W4M

PARTNERS:

Amoco Canada Petroleum Company Ltd. 100%

PROCESS: Pressure Cycle In Situ Air Combustion

COST: Capital -\$22.3 Million

Operating - \$3.9 Million for 1991

START-UP: June 1981

TERMINATION: 1995

DESCRIPTION

PILOT AREA: 260 ha

WELL PATTERN: Inverted 7-Spot

WELL SPACING: 4 ha/well

NO. OF WELLS:

Injection

Production

Observation

7
39
0

FACILITIES

STEAM GENERATOR(S): two - 26 GJ/hr

AIR COMPRESSORS: one - 90,600 m³/d @ 6.9 MPa

ARTIFICIAL LIFT METHODS: HEP Units and liner pumps

TREATER TYPE: Pressure and Flash treaters

STORAGE FACILITIES: Oil - 1500 m³,
Water - 800 m³

TRANSPORT: Husky Pipeline

RESERVOIR

Geological Horizon: Lloydminster A

Depth to Top of Formation: 580 m.KB

Reservoir Thickness:

net: 10 m

gross: 10 m

Original Temperature: 24°C

Original Pressure: 3230 kPa

Average Horizontal Permeability: 2000 md

Average Porosity: 30%

Average Water Saturation S_w 25%

Average Oil Saturation S_o 75% pore vol.

Oil Viscosity at Reservoir Temp. 5688 mPa.s

Oil Gravity at Reservoir Temp. 973 Kg/m³

Primary Production Rates: 2.2 m³/well/day

Source: Pilot Operator

COMMENTS: Air injection is marginally profitable at low oil prices. Air injection was re-started in December, 1991. Production response is expected in approximately six months.

BP Canada

Chauvin South Sparky 'E'

LOCATION

LSD: NW/4 Section: 24 Township: 42 Range: 3 W4M
 LSD: SW/4 Section: 25 Township: 42 Range: 3 W4M
 LSD: NE/4 Section: 26 Township: 42 Range: 3 W4M

PARTNERS:

BP Canada 100%

PROCESS: Mobility control polymer flood (using Xanthan - biopolymer)

COST: Capital - \$370,000
 Operating - \$1,000,000 (chemical cost for 3 yrs. inj.)
 \$120,000/yr (general)

START-UP: February 1988

TERMINATION: February 1992

DESCRIPTION

PILOT AREA: 794.25 ha

WELL PATTERN: 2 inverted 5-Spots; 1 partial peripheral injection pattern.

WELL SPACING: 16 ha

NO. OF WELLS:

Production

11
3

Injection (polymer)

FACILITIES

One polymer blending unit

ARTIFICIAL LIFT METHODS: Standard Pump Jack and Bottomhole Rotary Pumps

TREATER TYPE: Standard Heater/Treater

STORAGE FACILITIES:

Formaldehyde tank - 210 bbl

Polymer tank - 750 bbl

TRANSPORT: All wells flowlined.

RESERVOIR

Geological Horizon: Third Sparky Sand of the Mannville Group

Depth to Top of Formation: 650 m.KB

Reservoir Thickness:

net: 3.0 m

gross: 3.2 m

Original Temperature: 29°C

Original Pressure: 4785 kPa

Average Horizontal Permeability: 1200 md

Average Porosity: 30%

Average Water Saturation S_w : 19%

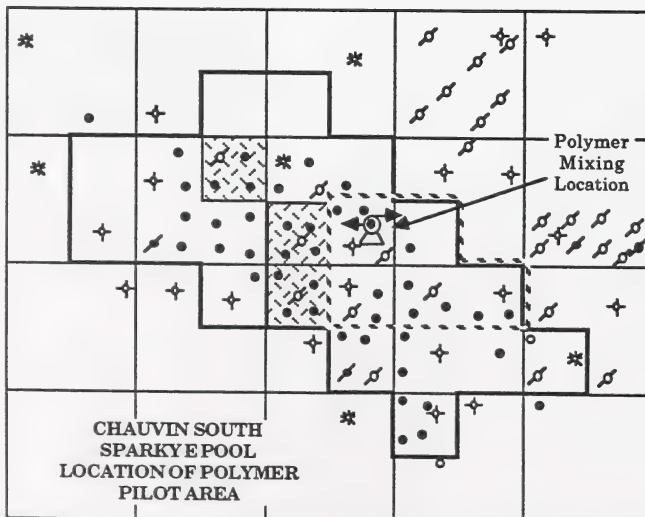
Average Oil Saturation S_o : 81% pore vol.

Oil Viscosity at Reservoir Temp.: 81 mPa.s

Oil Gravity at Reservoir Temp.: 920 Kg/m³

Primary Production Rates: 8 m³/well/day

Source: Pilot Operator



Bumper Development Corporation Ltd.

Twining Rundle 'A' Pool

LOCATION

LSD: 12 Section: 16 Township: 31 Range: 24
W4M

PARTNERS:

Bumper Development Corporation Ltd.
Enron Oil Canada Ltd.
AOSTRA

PROCESS: Re-completion of a Pekisko oil well by drilling a single horizontal drainhole.

COST: \$556,000

START-UP: October 1987

TERMINATION: January 1, 1992

DESCRIPTION

PILOT AREA: About 32 ha

WELL PATTERN: Single well

WELL SPACING: 32 ha

NO. OF WELLS:

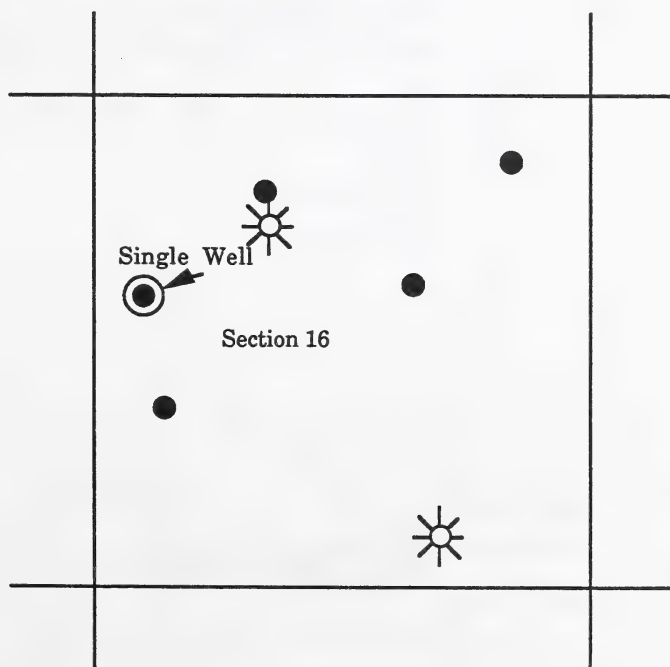
One production well only.

FACILITIES

ARTIFICIAL LIFT METHOD: Reciprocating sub-surface pump.

RESERVOIR

Producing Formation:	Pekisko of the Twining Rundle 'A' Pool
Depth to Top of Formation:	1660 m.KB
Reservoir Thickness:	
net:	15 m
gross:	40 m
Original Temperature:	61°C
Original Pressure:	11410 kPa
Average Horizontal Permeability:	5 md
Average Porosity:	5.7%
Average Water Saturation S_w	36%
Average Oil Saturation S_o	64%
Oil Viscosity at Reservoir Temp.	1.6 mPa.s
Oil Gravity at Reservoir Temp.	876 Kg/m ³
Primary Production Rates:	1 m ³ /well/day
Source:	Pilot Operator



CABRE EXPLORATION LTD.

Carrot Creek Horizontal Well

LOCATION

LSD: 13 Section: 8 Township: 52 Range: 12 W4M

PARTNERS:

Cabre Exploration Ltd.

COST: \$1,100,000

START-UP: August 17, 1991

TERMINATION: Ongoing

DESCRIPTION

WELL PATTERN: Irregular

WELL SPACING: 32 ha

NO. OF WELLS:

One Horizontal Well only

FACILITIES

ARTIFICIAL LIFT METHOD: Rotary Pump

RESERVOIR

Producing Formation:

Depth to Top of Formation:

Reservoir Thickness:

net:

Original Temperature:

Original Pressure:

Average Horizontal Permeability:

Average Porosity:

Average Water Saturation S_w

Average Oil Saturation S_o

Oil Viscosity at Reservoir Temp.

Oil Gravity at Reservoir Temp.

Primary Production Rates:

Source:

Cardium

1660 m.KB

3.2 m

57°C

10,310 kPa

40 md

10%

27%

73%

2.1 cp

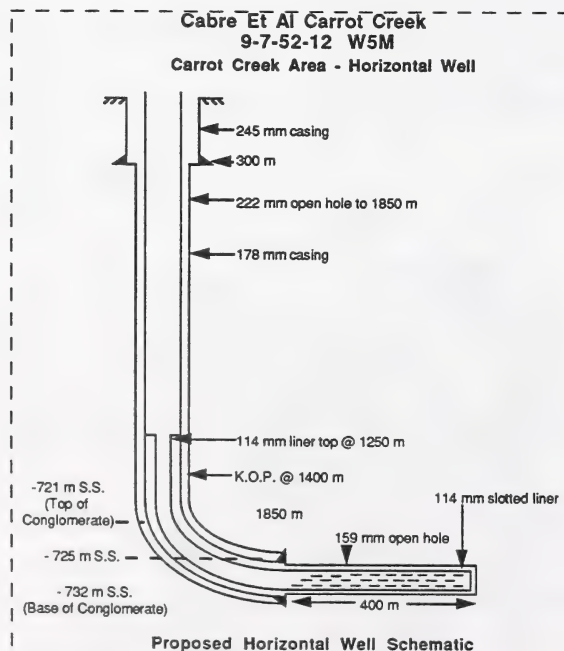
834 Kg/m³

120 m³/well/day

Pilot Operator

COMMENTS:

Long radius horizontal well drilled into a mature, poorly performing waterflood. Total measured depth of 2228 m with a 400 m horizontal section.



Canada Northwest Energy Ltd.

Atlee - Buffalo

LOCATION

Section: 19,20&30 Township: 21 Range: 5 W4M

PARTNERS:

Sceptre Resources Limited	31.9771%
Murphy Oil	10.1835%
Canada Northwest Energy Ltd.	57.8394%

PROCESS: Cyclic Steam

COST: Capital - Using existing wells and facilities

START-UP: February 1, 1986

TERMINATION: Unknown at present.

DESCRIPTION

WELL PATTERN: Conventional 40 acre spacing at present.

WELL SPACING: 40 acre spacing

NO. OF WELLS:

10 huff and puff existing

FACILITIES

STEAM GENERATOR(S): one - 23.2 GJ/hr

ARTIFICIAL LIFT METHODS: Pump Jacks

TREATER TYPE: Colt

TRANSPORT: Truck to Bow River Terminal at Jenner

RESERVOIR

Geological Horizon:	Glauconite
Depth to Top of Formation:	892 m.KB
Reservoir Thickness:	
net:	10 m
gross:	10 m
Original Temperature:	26°C
Original Pressure:	10000 kPa
Average Horizontal Permeability:	2000 md
Average Porosity:	29%
Average Water Saturation S_w	23%
Average Oil Saturation S_o	77% pore vol.
Oil Viscosity at Reservoir Temp.	800 mPa.s
Oil Gravity at Reservoir Temp.	951 Kg/m ³
Primary Production Rates:	less than 5 m ³ /well/day
Source:	Pilot Operator

COMMENTS: Shut-in pending higher oil prices. Potential of steamflooding is being reviewed. Current reservoir pressure is too low to justify a large scale cyclic steam operation.

Canadian Hunter Exploration Ltd.

Swan Hills Beaverhill Lake

LOCATION

LSD: 13 Section: 11 Township: 67 Range: 8 W4M

PARTNERS:

Canadian Hunter Exploration Ltd.	50%
AOSTRA	50%

PROCESS: Horizontal well recovery from a tight carbonate reservoir.

COST: \$1,500,000 drill (not completed)

START-UP: January 1988

TERMINATION: Currently suspended

RESERVOIR

Geological Horizon:	Swan Hills Beaverhill Lake Formation
Depth to Top of Formation:	2268 m.KB

Reservoir Thickness:	
gross:	14 m

Original Temperature:	83.5°C
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Original Pressure:	21000 kPa
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Average Porosity:	5%
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Average Water Saturation S_w	14%
--------------------------------	-----

Average Oil Saturation S_o	84% pore vol.
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Oil Gravity at Surface Temp.	43°API
Source:	Pilot Operator

DESCRIPTION

PILOT AREA: Single well

NO. OF WELLS: 1

FACILITIES

ARTIFICIAL LIFT METHODS: Conventional rod pump and pump jack

TRANSPORT: Truck fluid out.

Chevron Canada Resources Ltd.

Steepbank HASDrive

LOCATION

LSD: E 1/2 Section: 22 Township: 94 Range: 7
W4M

PARTNERS:

Chevron Canada Resources 100%

PROCESS: Heated Annulus Steam Drive
(HASDrive)

COST: Capital - \$13,000,000

START-UP: November 1, 1991

TERMINATION: December 1997

DESCRIPTION

PILOT AREA: 4.38 hectares

WELL PATTERN: Irregular

WELL SPACING: Irregular

NO. OF WELLS:

Injection	1
Producing	1
HAS Well	1
Temperature Observation	6
Cross Hole Tomography	4

FACILITIES

STEAM GENERATORS: 1-23 GJ/hr and 1-26 GJ/hr

ARTIFICIAL LIFT METHODS: Conventional Pump
Jack

TREATER TYPE: Horizontal, 3 phase, thermal

STORAGE FACILITIES: Two - 320 m³ insulated
heat traced tanks

TRANSPORT: Tank Truck

RESERVOIR

Geological Horizon: McMurray

Depth to Top of Formation: 186 m.KB

Reservoir Thickness:

net: 54 m

gross: 74 m

Original Temperature: 10°C

Original Pressure: 500 kPa

Average Horizontal Permeability: 4000-6000 md

Average Porosity: 32%

Average Water Saturation S_w : 20%

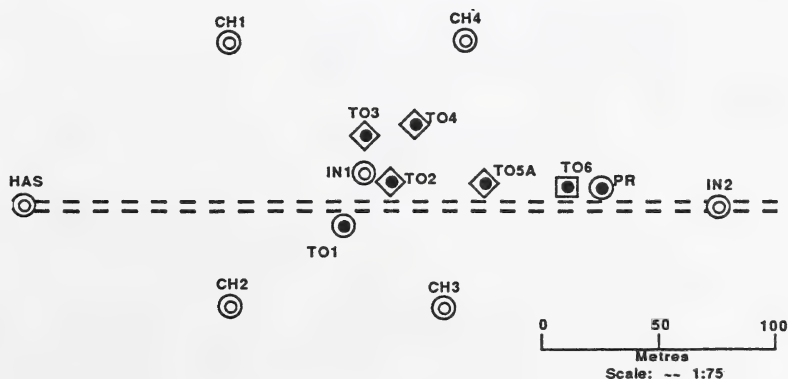
Average Oil Saturation S_o : 80% pore vol.

Oil Viscosity at Reservoir Temp. 2.0×10^6 mPa.s

Oil Gravity at Reservoir Temp. 1015 Kg/m³

Primary Production Rates: Nil m³/well/day
Source: Pilot Operator

COMMENTS: High pressure steam is circulated in the unperforated horizontal well to heat the oil sand. Low pressure steam is injected into the injection wells to push heated bitumen to the producing well.



Chevron Canada Resources Ltd.

Taber

LOCATION

LSD: 9 Section: 18 Township: 9 Range: 16 W4M

PARTNERS:

NCE Oil & Gas (88-1) Ltd.	5.9%
Anadarko	4.3%
Koch Exploration	2.8%
Norcen Energy Ltd.	1.7%
Other	2.6%

PROCESS: Polymer Flood

COST: Capital - \$1.3 Million

Operating - \$1.15 Million/year

START-UP: June 1987 (commenced continuous polymer injection)

TERMINATION: 1996

DESCRIPTION

PILOT AREA: 194 ha

WELL PATTERN: Irregular pattern

WELL SPACING: 16 ha

NO. OF WELLS:

Injection	2
Production	7
Observation	0

FACILITIES

ARTIFICIAL LIFT METHODS: 5 Pump Jacks, 1 electrical sub pump, 1 pump progressing cavity

TREATER TYPE: C.E. NATCO - dual polarity

STORAGE FACILITIES: Two - 80 m³ tanks

TRANSPORT: Pipeline

RESERVOIR

Geological Horizon: Upper Mannville
Glaucconitic Sandstone

Depth to Top of Formation: 971 m.KB

Reservoir Thickness:

net: 8.1 m

gross: 9.0 m

Original Temperature: 35°C

Original Pressure: 10170 kPa

Average Horizontal Permeability: 1140 md

Average Porosity: 22.3%

Average Initial Water Saturation S_w : 25%

Average Oil Saturation S_o : initial 75% pore vol.
current 49.4% pore vol.

Oil Viscosity at Reservoir Temp. 55 mPa.s

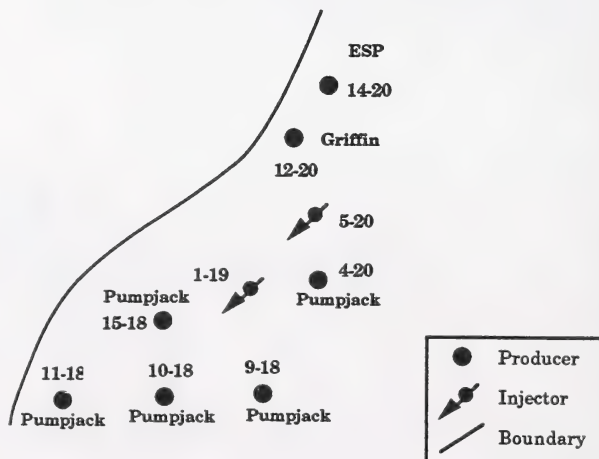
Oil Gravity at Reservoir Temp. 900 Kg/m³

Primary Production Rates: Max. 25 m³/well/day

Avg. 2.7 m³/well/day

Source: Pilot Operator

COMMENTS: Polymer slug is tapered during last 4 years. The scheme is classified as experimental and encompasses 2/3 of the entire pool in unit 1. Note: The pilot is still operating.



Cimarron Petroleum Ltd.

Del Bonita Rundle Pool

LOCATION

LSD: 3 Section: 19 Township: 1 Range: 21 W4M

PARTNERS:

Cimarron Petroleum Ltd. 67%
AOSTRA 33%

PROJECT: Drilling a horizontal well in the Rundle formation

START-UP: November 30, 1991

TERMINATION: January 31, 1992

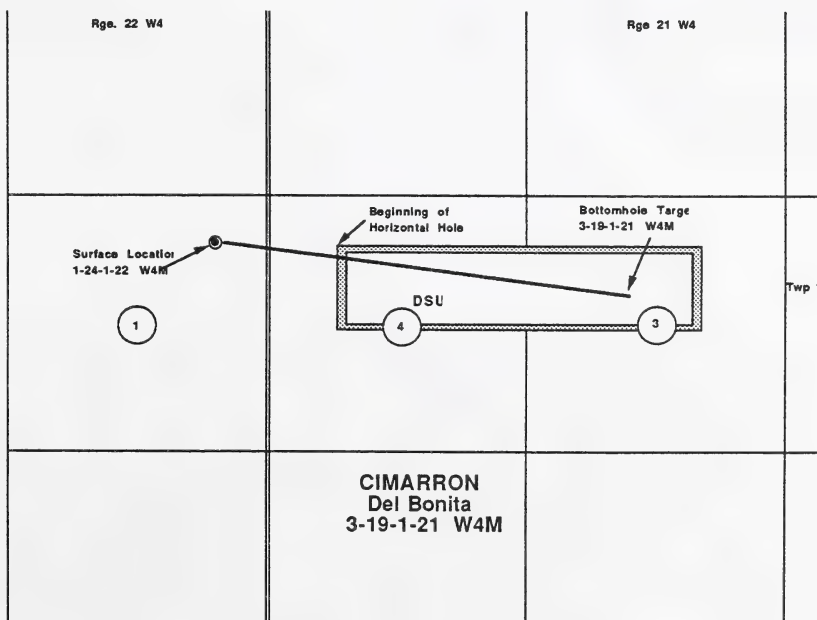
DESCRIPTION

Drilling a well at surface location 1-24-1-22 W4M with a 400 m horizontal section in the Rundle formation targeted for 3-19-1-21 W4M.

NO. OF WELLS: one

RESERVOIR:

Formation	Rundle
Depth to Top of Formation	1565
Reservoir Thickness	
net	30 m
gross	40 m
Original Temperature	44°C
Original Pressure	13000 kPa
Horizontal Permeability	low but fractures are present
Average Porosity	8%
Average Water Saturation Sw	25%
Average Oil Saturation So	75%
Oil Gravity at Reservoir Temp	840 Kg/m ³
Average Initial Production Rate of Vertical Wells	3 m ³ /well/d
Source	Pilot Operator



Esso Resources Canada Ltd.

Fisher Creek

LOCATION

LSD: 3 Section: 1 Township: 67 Range: 6 W4M

PARTNERS:

Esso Farm in on AEC lands.

PROCESS: Cyclic Steam Stimulation

COST: Capital - \$1.3 Million (10 km perm. access road) + \$0.5 Million (facilities)
Operating - \$0.8 Million (Rental, trucking, etc.)

START-UP: 1986

TERMINATION: Currently on hold, pending completion of production/injection data study.

DESCRIPTION

WELL PATTERN: Single well pilot.

NO. OF WELLS:

Injection/Production - single well pilot

FACILITIES

STEAM GENERATOR(S): Portable equipment used, currently not on site. 31.7 GJ/hr.

ARTIFICIAL LIFT METHODS: Pump-jack 4w co-rod etc.

TREATER TYPE: Atmospheric Treater

STORAGE FACILITIES: Tank Farm

TRANSPORT: Truck - all fluids

RESERVOIR

Geological Horizon	Clearwater
Depth to Top of Formation:	460 m.KB
Reservoir Thickness:	
gross:	15-50 m
Original Temperature:	15°C
Original Pressure:	3000 kPa
Average Horizontal Permeability:	700 md
Average Porosity:	29%
Average Water Saturation S_w	0.54-0.68%
Average Oil Saturation S_o	0.46-0.32% pore vol.
Oil Viscosity at Reservoir Temp.	30000-
	100000 mPa.s
Oil Gravity at Reservoir Temp.	980 Kg/m ³
Source:	Pilot Operator

COMMENTS: Operations suspended August, 1986. Analysis followed and a report was issued February, 1988. No further work is planned at this time.

Esso Resources Canada Ltd.

Leming

LOCATION

Section: 4-8 Township: 65 Range: 3 W4M

PARTNERS:

Esso Resources Canada Ltd. 100%

PROCESS: Cyclic Steam Stimulation,
Displacement, Horizontal Wells

COST: Capital - \$227 Million

START-UP: January 1975

TERMINATION: On going

DESCRIPTION

PILOT AREA: 1295 ha

WELL PATTERN: Various cluster patterns - see
diagram

WELL SPACING: 0.7, 0.8, 0.94, 1.6, 2.9 ha

NO. OF WELLS:

Injection/Production 496

Observation 55

FACILITIES

STEAM GENERATOR(S):

2 - 137.3 GJ/hr. (Produced water)

1 - 156.3 GJ/hr. (Fresh water)

2 - 52.75 GJ/hr. (Fresh water)

5 - 42.3 GJ/hr. (Fresh water)

Generator ratings are based on heat input to
the water.

ARTIFICIAL LIFT METHODS: Pump Jacks, Hydro-
beam, HEP

TREATER TYPE: Electro Static Grid (NATCO)

STORAGE FACILITIES: Tanks

TRANSPORT: Pipeline

RESERVOIR

Geological Horizon: Clearwater

Depth to Top of Formation: 440 m.KB

Reservoir Thickness:

net: 45 m

gross: 50 m

Original Temperature: 13°C

Original Pressure: 3100 kPa

Average Horizontal Permeability: 1500 md

Average Porosity: 35%

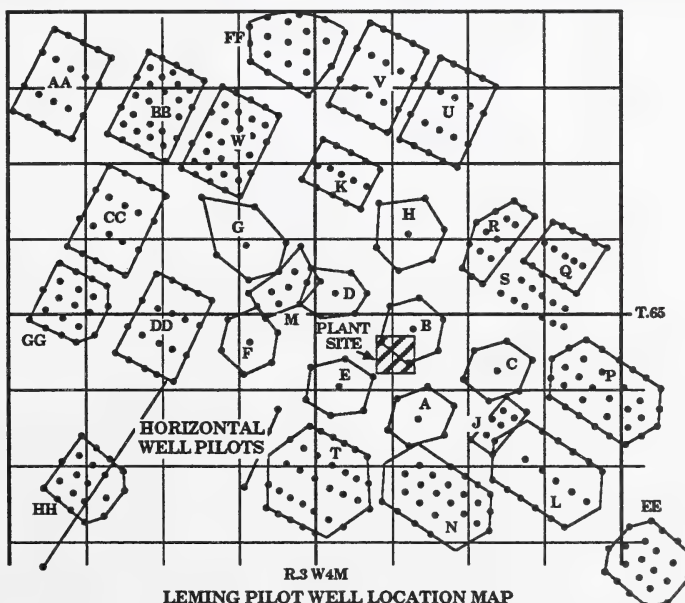
Average Water Saturation S_w 30%

Average Oil Saturation S_o 70% pore vol.

Oil Viscosity at Reservoir Temp. 100000 mPa.s

Oil Gravity at Reservoir Temp. 995 Kg/m³

Source: Pilot Operator



Esso Resources Canada Ltd.

May/Ethel

LOCATION

Section: 22,27,28 Township: 64 Range: 3 W4M

PARTNERS:

Esso Resources Canada Ltd. 100%

PROCESS: Cyclic Steam Stimulation,
Displacement and Borehole Mining.

COST: Capital - \$70 Million

START-UP: May - 1972
Ethel - 1964 (Abandoned)

TERMINATION: Ongoing

DESCRIPTION

PILOT AREA: 777 ha

WELL PATTERN: See Diagram

WELL SPACING: 1 and 2 ha

NO. OF WELLS:

Injection/Production 106
Observation 8

FACILITIES

STEAM GENERATOR(S): 4 - 52.75 GJ/hr, 1 - 26.00 GJ/hr, 1 - 10.60 GJ/hr

ARTIFICIAL LIFT METHODS: Standard Pump Jacks

TREATER TYPE: Electrostatic Grid (NATCO)

STORAGE FACILITIES: Tanks

TRANSPORT: Pipeline

RESERVOIR

Geological Horizon: Clearwater

Depth to Top of Formation: 440 m.KB

Reservoir Thickness:

net: 45 m

gross: 55 m

Original Temperature: 13°C

Original Pressure: 3033 kPa

Average Horizontal Permeability: 1500 md

Average Porosity: 35%

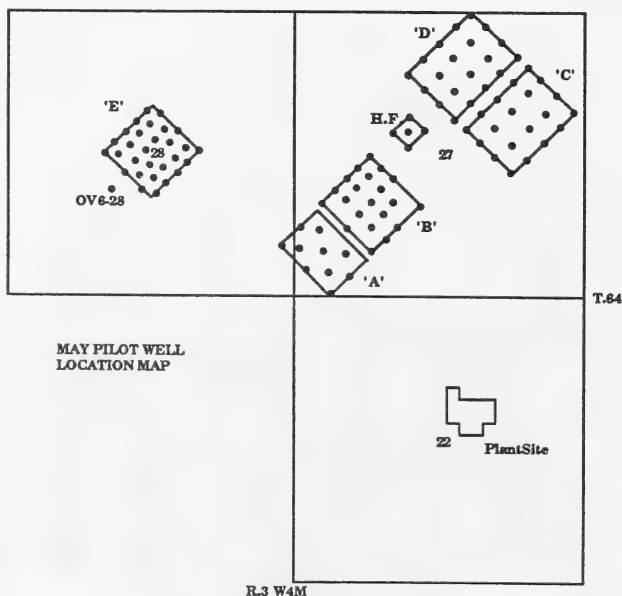
Average Water Saturation S_w : 30%

Average Oil Saturation S_o : 70% pore vol.

Oil Viscosity at Reservoir Temp. 100000 mPa.s

Oil Gravity at Reservoir Temp. 95 Kg/m³

Source: Pilot Operator



Esso Resources Canada Ltd.

Rainbow

LOCATION

LSD: 3 Section: 11 Township: 110 Range: 7 W6M

PARTNERS:

Esso Resources Canada Limited 100%

PROCESS: Drainhole in bottom water drive pool.

COST: Capital: 1.32 M\$
Operating: 30 K\$/year

START-UP: April 9, 1987

TERMINATION: Currently Suspended

DESCRIPTION

PILOT AREA: 65 ha

NO. OF WELLS:

Injection	0
Production	1
Observation	0

FACILITIES

ARTIFICIAL LIFT METHODS: Pump Jack

RESERVOIR

Geological Horizon: Keg River

Depth to Top of Formation: 1,670 m.KB

Reservoir Thickness:
net: 19.6 m

gross: 23 m

Original Temperature: 84°C

Original Pressure: 15,620 kPa

Average Horizontal Permeability: 200 md

Average Porosity: 4.5%

Average Water Saturation S_w 22%

Average Oil Saturation S_o 78% pore volume

Oil Gravity at Reservoir Temp. 797 Kg/m³

Primary Production Rates: 60 m³/well/day

Source: Pilot Operator

COMMENTS: This well is currently suspended. The well was unsuccessful as it penetrated an overlying water zone. It is believed that excessive water was produced from the upper most section of the open hole drainhole.

Esso Resources Canada Ltd.

Redwater

LOCATION

LSD: All Section: 29 Township: 57 Range: 21 W4M
LSD: 4,5,12&13 Section: 28 Township: 57 Range: 21 W4M

LSD: 1,2,3 & 4 Section: 32 Township: 57 Range: 21 W4M

LSD: 4 Section: 33 Township: 57 Range: 21 W4M

PARTNERS:

Esso Resources Canada Ltd. 100%

PROCESS: Enriched Hydrocarbon Miscible Flood

COST: (Cumulative to date)

Capital - \$4.8 Million

Operating - \$13.1 Million

START-UP: January 1985

TERMINATION: January 1994

DESCRIPTION

PILOT AREA: 404.7 ha

WELL PATTERN: 4 inverted 5-spot injection patterns

WELL SPACING: 8.094 ha

PATTERN SPACING: 16.2 ha

NO. OF WELLS:

Injection	4
Observation Well	1
Production (in the injection patterns)	9

16 producers to contain the injection patterns

FACILITIES

One gas compressor: 28,000 m³/d @ 9.7 MPa capacity

ARTIFICIAL LIFT METHODS: Electric Submersible pumps

TRANSPORT: NGL Pipeline

RESERVOIR

Geological Horizon: Upper Devonian Leduc D3

Depth to Top of Formation: 903 m.KB

Reservoir Thickness:
net: 31.39 m

Original Temperature: 34.6°C

Original Pressure: 7450 kPa

Average Horizontal Perm.: 40-200 (Foreslope) md
100-1500 (Backreef) md

Average Porosity: 6%(Backreef)
12% (Foreslope)

Average Water Saturation S_w 25%

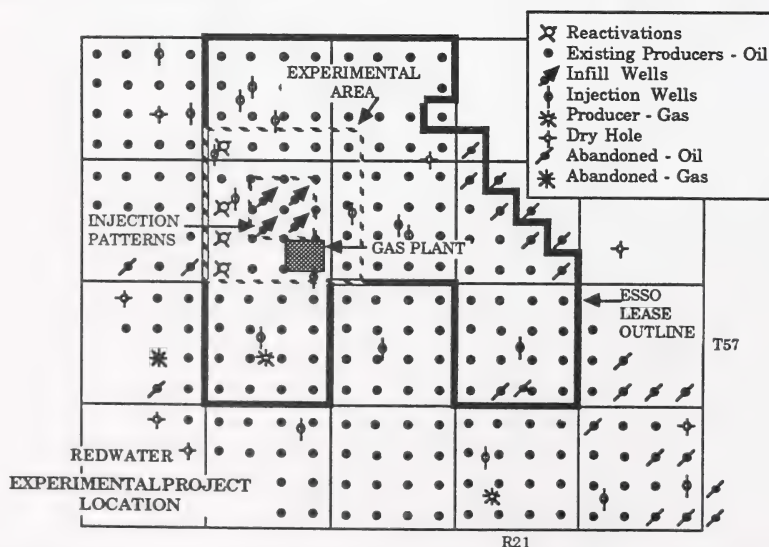
Average Oil Saturation S_o 75% pore vol.

Oil Viscosity at Reservoir Temp. 2.7 mPa.s

Oil Gravity at Reservoir Temp. 844 Kg/m³

Primary Production Rates: 1-8 m³/well/day

Source: Pilot Operator



COMMENTS: The first pattern was flooded beginning October, 1987 for approximately 6 months and the second pattern was flooded in the first half of 1989. Solvent injection into the third of four patterns is scheduled for 1991. Chase gas injection will follow completion of solvent injection into the third pattern.

Gulf Canada Resources Ltd.

Fenn-Big Valley

LOCATION

LSD's.: 2 & 6 Section: 23 Township: 35 Range: 20
W4M

PARTNERS:

Gulf Canada Resources Ltd.
AOSTRA

PROCESS: Nitrogen Injection

COST: \$1.6 MM (est.)

START-UP: July 16, 1987

TERMINATION: Continuing

DESCRIPTION

PILOT AREA: Approximately 30 ha

WELL PATTERN: 2-spot

WELL SPACING: 16 ha

NO. OF WELLS:

Injection	1
Production	1

FACILITIES

ARTIFICIAL LIFT METHODS: Bottom hole pump

TREATER TYPE: Wellhead Separator, Group
Battery

TRANSPORT: Satellite gathering system.

RESERVOIR

Geological Horizon:	Leduc (D-3)
Depth to Top of Formation:	1644.1 m.KB
Reservoir Thickness:	
initial net oil pay:	3.81 m
initial gross oil pay:	4.00 m
Original Temperature:	59°C
Original Pressure:	12,510 kPa
Average Horizontal Permeability:	800 (est.) md
Average Porosity:	8.5%
Average Water Saturation S_w	15%
Average Oil Saturation S_o	85% pore volume
Oil Viscosity at Reservoir Temp.	0.8 mPa.s
Oil Gravity at Reservoir Temp.	876 Kg/m ³
Primary Production Rates:	9.0 m ³ /well/day
Source:	Pilot Operator

COMMENTS: The Experimental Scheme is planned and directed toward field testing of two processes never before applied in Alberta:

- improved recovery of oil, NGL's and sulphur from a Devonian carbonate reef with nitrogen.
- control of fluid interfaces within a Devonian carbonate reef by the injection of nitrogen to optimize oil recovery by an immiscible process.

Home Oil Company Ltd.

Kitscoty

LOCATION

LSD: 2,3,4 Section: 2 Township: 51 Range: 2
W4M

PARTNERS:

CS Resources Ltd.	17.5%
Home Oil Company Ltd.	82.5%

PROCESS: Cyclic Steam and Steamflood

COST: Capital - 9×10^6 or \$10,000,000 for
Phase I, II and III
Operating - N/A

START-UP: 1981

TERMINATION: 1992

DESCRIPTION

WELL PATTERN: One five spot and two six spot
and 3 single Huff and Puff wells

WELL SPACING: 2 ha

NO. OF WELLS:

Producing thermal wells	13
Producing primary wells	2
Water alternating steam injectors	2
Water disposal well	1
Gas Supply Well	1
Water source well	1

FACILITIES

STEAM GENERATOR(S): one - 26.37 GJ/hr steam
generator

STORAGE FACILITIES: Tanks

TRANSPORT: Trucks

RESERVOIR

Geological Horizon: Sparky Sand
Depth to Top of Formation: 570 m.KB

Reservoir Thickness:
net: 19 m
gross: 26 m

Original Temperature: 15°C

Original Pressure: 3400 kPa

Average Horizontal Permeability: 2000-3000 md

Average Porosity: 30%

Average Water Saturation S_w : 20%

Average Oil Saturation S_o : 80% pore volume

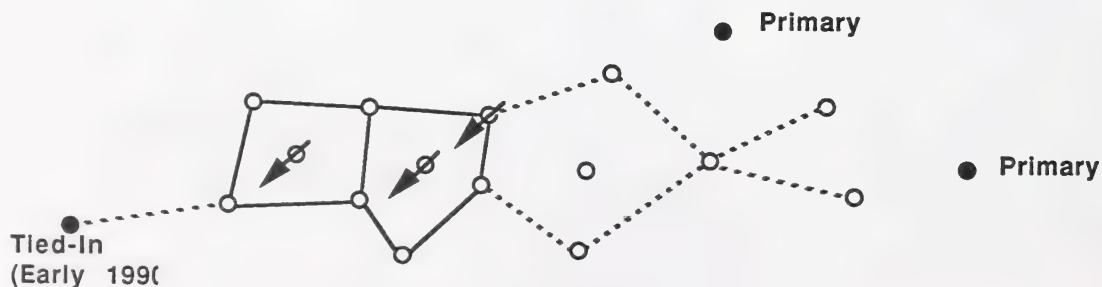
Oil Viscosity at Reservoir Temp. 8000 mPa.s

Oil Gravity at Reservoir Temp. 985 Kg/m³

Primary Production Rates: 5 m³/well/day
Source: Pilot Operator

COMMENTS:

In 1989 Home Oil converted two wells to continuous water/steam injectors. In 1990 another existing thermal well was tied in to the project.



Husky Oil Ltd.

Caribou Lake

LOCATION

Section: 12 Township: 69 Range: 5 W4M

PARTNERS:

Husky Oil Ltd.
AEC Oil & Gas Company

PROCESS: Cyclic Steam Stimulation

COST: \$22 Million

START-UP: March, 1991

TERMINATION: Ongoing

DESCRIPTION

PILOT AREA: 40 ha

WELL PATTERN: elongated, inverted 7-spot

WELL SPACING: 1.6 ha/well

NO. OF WELLS:

Injection/production wells 25

FACILITIES

STEAM GENERATOR(S): 1-50 MMBTU/hr

1-25 MMBTU/hr

ARTIFICIAL LIFT METHODS: Conventional Pump
Jacks

TREATER TYPE: Horizontal, 3 phase, electrostatic

STORAGE FACILITIES: Lease Tanks

TRANSPORT: Trucking

RESERVOIR

Geological Horizon: Clearwater B

Depth to Top of Formation: 450 m.KB

Reservoir Thickness:

net: 22 m

gross: 25 m

Original Temperature: 16°C

Original Pressure: 2800 kPa

Average Horizontal Permeability: 1500 md

Average Porosity: 33%

Average Water Saturation S_w : 40%

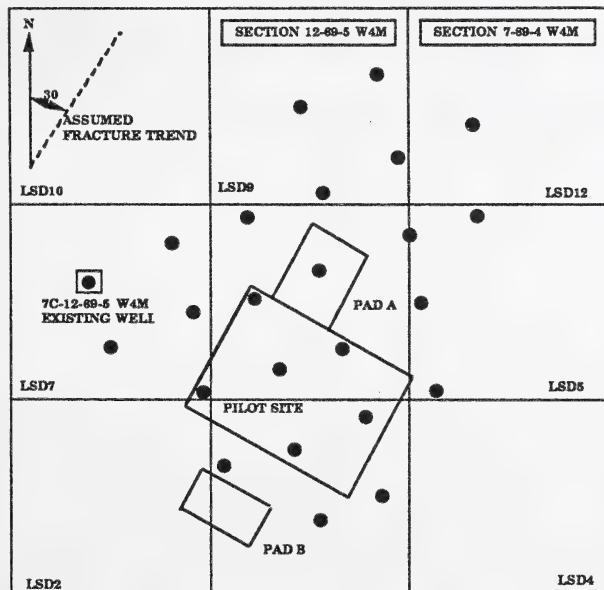
Average Oil Saturation S_o : 60% pore volume

Oil Viscosity at Reservoir Temp: 33,000-

69,000 mPa.s

Oil Gravity at Reservoir Temp. 990 Kg/m³

Source: Pilot Operator



HUSKY OIL OPERATIONS LTD.
CaribouLakePilot

LEGEND

● PILOT WELLS

Koch Exploration Canada Ltd.

Fort Kent

LOCATION

LSD: 11 Section: 19 Township: 61 Range: 4 W4M

PARTNERS:

Koch Exploration Canada Ltd. 100%

PROCESS: Cyclic Steam Steam Drive

START-UP: December 13, 1985

TERMINATION: N/A

DESCRIPTION

PILOT AREA: 130 hectares

WELL PATTERN: 5-spot

WELL SPACING: 5 acre

NO. OF WELLS:

Production/injection 27

Water Disposal Well 3

Water Source Well 1

FACILITIES

STEAM GENERATOR(S): one - 30 MM BTU/Hr

one - 50 MM BTU/HR

ARTIFICIAL LIFT METHODS: Bottom Hole Pump

TREATER TYPE: FWKO & Electrostatic Treater

STORAGE FACILITIES: Tanks

TRANSPORT: Husky Pipeline to Lloydminster

RESERVOIR

Geological Horizon: Upper Grand Rapids

Depth to Top of Formation: 345 m.KB

Reservoir Thickness:

net: 15 m

gross: 17 m

Original Temperature: 21°C

Original Pressure: 3500 kPa

Average Horizontal Permeability: 2000 md

Average Porosity: 35%

Average Water Saturation S_w 30%

Average Oil Saturation S_o 70% pore volume

Oil Viscosity at Reservoir Temp. 30,000 mPa.s

Oil Gravity at Reservoir Temp. 992 Kg/m³

Source: Pilot Operator

Mobil Oil Canada, Ltd.

Iron River

LOCATION

LSD: 11, 12, 13, 14 Section: 6 Township: 64
Range: 4 W4M

PARTNERS:

Mobil Oil Canada, Ltd. 100%

PROCESS: Cyclic Steam Stimulation

COST: \$14 Million

START-UP: March 15, 1988

TERMINATION: Approval Expires April 30, 1992
Shut down March 1991

DESCRIPTION

PILOT AREA: 160 acres

WELL PATTERN: See diagram

WELL SPACING: 4 acre; 8 acre

NO. OF WELLS:

Injectors/Producers	23
Observation Wells	3

FACILITIES

STEAM GENERATOR(S): two - 26 GJ/hr steam generator

ARTIFICIAL LIFT METHODS: Slant and Conventional Pump Jacks, progressive cavity pumps.

TREATER TYPE: Production flowlined to nearby Iron River Battery, with on site treating and water disposal employing a pressure treater.

TRANSPORT: Clean oil is trucked to Husky Tucker Lake terminal.

RESERVOIR

Geological Horizon: Lower Grand Rapids (Sparky)

Depth to Top of Formation: 360 m.KB

Reservoir Thickness:

net: 19 m

gross: 27 m

Original Temperature: 15°C

Original Pressure: 2500 kPa

Average Horizontal Permeability: 500-2000 md

Average Porosity: 35%

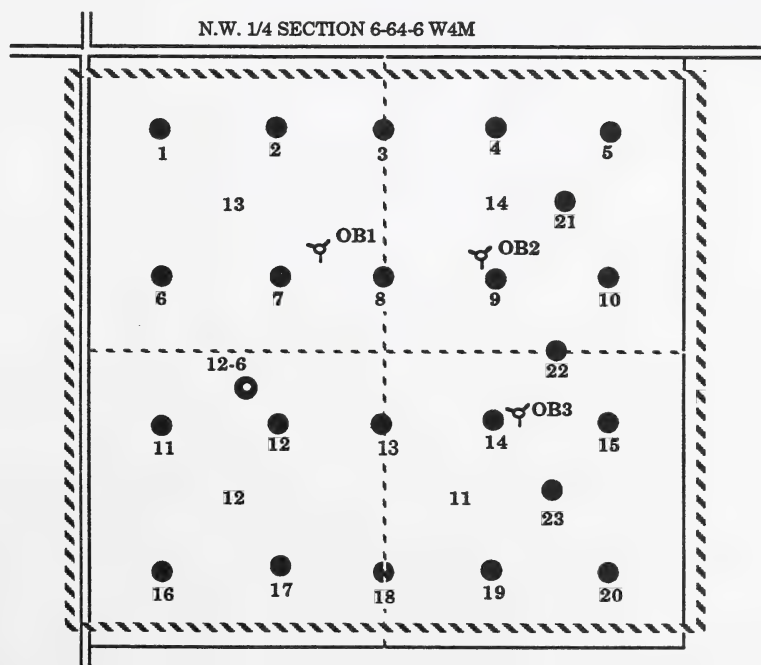
Average Water Saturation S_w 35%

Average Oil Saturation S_o 65% pore volume

Oil Viscosity at Reservoir Temp. 50,000 mPa.s

Oil Gravity at Reservoir Temp. 988 Kg/m³

Source: Pilot Operator



Mobil Oil Canada, Ltd.

Muskeg River

LOCATION

LSD: 6 Section: 14 Township: 57 Range: 7 W6M

PARTNERS:

Mobil Oil Canada, Ltd.
Chevron Canada Resources

PROCESS: Coalbed Methane Project

START-UP: August 6, 1991

DESCRIPTION

Completion and production testing of well for coalbed methane gas potential.

PILOT AREA: 1 section

WELL SPACING: 1 section

NO. OF WELLS: One

FACILITIES

ARTIFICIAL LIFT METHODS: Progressive cavity pump.

STORAGE FACILITIES: Two 64 m³ tanks

TRANSPORT: Water trucked to Clairmont disposal site in Grande Prairie.

RESERVOIR

Geological Horizon:

Depth to Top of Formation:

Reservoir Thickness:

gross:

Original Temperature:

Source:

Grand Cache

552.30 m.KB

8.7 m

27°C

Pilot Operator

Norcen Energy Resources Ltd.

Boyer Horizontal Well 1

LOCATION

LSD: 3 Section: 20 Township: 104 Range: 1 W6M

PARTNERS:

Norcen Energy Resources Limited

COST: \$860,000

DESCRIPTION

Producing Gas Well

PILOT AREA: two sections

WELL PATTERN: N/A

NO. OF WELLS: One

FACILITIES

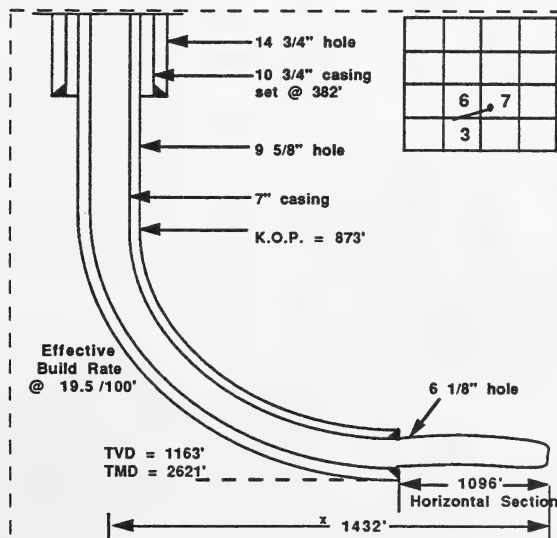
This well is drilled into a low pressure gas reservoir with fairly low permeability. The objective of the horizontal well is to increase productivity and decrease water production which usually occurs after hydraulic fracturing.

RESERVOIR

Geological Horizon:	Bluesky
Depth to Top of Formation:	380 m
Reservoir Thickness:	
net:	7.5 m
gross:	10.5 m
Original Temperature:	29°C
Original Pressure:	<2400 kPa
Average Horizontal Permeability:	20 mD
Average Porosity:	20%
Average Water Saturation S_w	55%
Source:	Pilot Operator

COMMENTS: Uncemented 114.3 mm, 17.3 kg/m, MN-80, LT&C liner to TD in 159 mm redrilled hole. Alternated slotted and unslotted joints of casing. Open ended 60.3 mm tubing landed near end of lateral. February 1990. March 1989 completion hole failure.

Drilling rig displaced mud out with methanol. Reverse displace well to N2 and continue unload well with coil tubing and N2 after 5 days shut in. Flow unloading methanol/drilling mud residue mist. Intermittent flows to clean up.



Norcen Energy Resources Ltd.

Boyer Horizontal Well 2

LOCATION

LSD: 7 Section: 28 Township: 104 Range: 1 W6M

PARTNERS:

Norcen Energy Resources Limited

COST: \$700,000

DESCRIPTION

Producing Gas Well

PILOT AREA: two sections

WELL PATTERN: N/A

NO. OF WELLS: One

FACILITIES

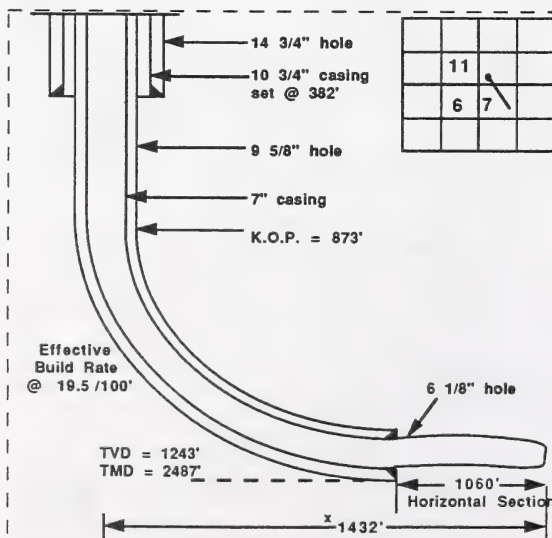
This well is drilled into a low pressure gas reservoir with fairly low permeability. The objective of the horizontal well is to increase productivity and decrease water production which usually occurs after hydraulic fracturing.

RESERVOIR

Geological Horizon:	Bluesky
Depth to Top of Formation:	380 m
Reservoir Thickness:	
net:	7.5 m
gross:	10.5 m
Original Temperature:	29°C
Original Pressure:	<2400 kPa
Average Horizontal Permeability:	20 mD
Average Porosity:	20%
Average Water Saturation S_w	55%
Source:	Pilot Operator

COMMENTS: Intermediate with drilling rig. 156 mm open hole. Open ended 60.3 mm tubing landed at start of lateral. March 1989.

With 60.3 mm tubing at TD, reverse displaced hole to N2 and flowed well to clean up. Good flow. Circulated well with methanol to kill/cleanout/reposition tubing. Reverse displaced to N2. No flow, unloaded well with coil tubing and N2. Good flow after cleanup.



Norcen Energy Resources Ltd.

Lindbergh I

LOCATION

LSD: 3,4,6,9,16 Section: 13 Township: 55 Range: 6 W4M
 LSD: 16 Section: 21 Township: 55 Range: 6 W4M
 LSD: 10 Section: 15 Township: 55 Range: 5 W4M
 LSD: 06 Section: 21 Township: 55 Range: 5 W4M
 LSD: 10 Section: 01 Township: 55 Range: 6 W4M
 LSD: 10 Section: 15 Township: 56 Range: 6 W4M
 LSD: 14 Section: 01 Township: 56 Range: 6 W4M
 LSD: 7 Section: 27 Township: 55 Range: 6 W4M
 LSD: 2 Section: 35 Township: 55 Range: 6 W4M

PARTNERS:

Norcen Energy Resources Ltd. 100%

PROCESS: Cyclic Huff & Puff

COST: \$7,300,000

START-UP: May 1982

TERMINATION: January 31, 1992

DESCRIPTION

PILOT AREA: 178 ha

WELL PATTERN: Single Well

WELL SPACING: 16 ha

NO. OF WELLS:

Injection/Production 13

Observation 0

FACILITIES

STEAM GENERATOR(S): two - 23.2 GJ/hr steam generators

ARTIFICIAL LIFT METHODS: Conventional Tubing Pump and Pump Jack System

TREATER TYPE: H.T.I. Pump Jack System

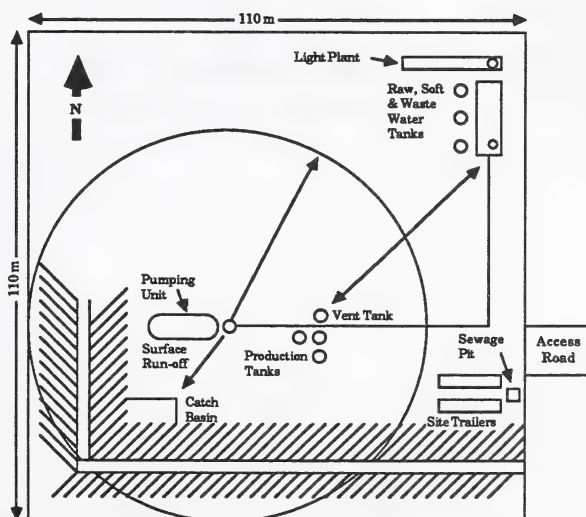
STORAGE FACILITIES: 119 m³ Tanks/Well

TRANSPORT: Trucked to Westmin Cleaning Plant and shipped via Husky pipeline to Lloydminster.

RESERVOIR

Geological Horizon:	Cummings
Depth to Top of Formation:	600 m.KB
Reservoir Thickness:	
net:	12.6 m
gross:	15.0 m
Original Temperature:	24°C
Original Pressure:	3900 kPa
Average Horizontal Permeability:	2400 md
Average Porosity:	30%
Average Water Saturation S_w	20%
Average Oil Saturation S_o	80% pore volume
Oil Viscosity at Reservoir Temp.	9800 mPa.s
Oil Gravity at Reservoir Temp.	986 Kg/m ³
Primary Production Rates:	5.0 m ³ /well/day
Source:	Pilot Operator

COMMENTS: Experimental Operations
 Continuing at all locations.



Norcen Energy Resources Ltd.

Lloydminster Horizontal Well

LOCATION

LSD: 3, 4, & 5 Section: 36 Township: 50 Range: 2
W4M

PARTNERS:

Norcen Energy Resources Ltd.

PROCESS: Horizontal primary production

START-UP: February 1989

TERMINATION: On-going

DESCRIPTION

Lloydminster Horizontal Well - to evaluate productivity improvements and increased recovery of a horizontal well compared to a vertical well.

PILOT AREA: 120 acres special spacing unit (see attached map)

WELL PATTERN: Single well

WELL SPACING: 40 acres

NO. OF WELLS: 1

FACILITIES

ARTIFICIAL LIFT METHODS: Progressive cavity pump

STORAGE FACILITIES: Lease tank

TRANSPORT: Trucked

RESERVOIR

Geological Formation: Sparky "B"

Depth to Top of Formation: 585 m

Reservoir Thickness:
net: 7.5 m

gross: 10.4 m

Original Temperature: 20°C

Original Pressure: 3718 kPa

Average Horizontal Permeability: 1-3 Darcies

Average Porosity: 29%

Average Water Saturation S_w : 80%

Average Oil Saturation S_o : 20%

Live Oil Viscosity at Reservoir Temp. 2270 mPa.s

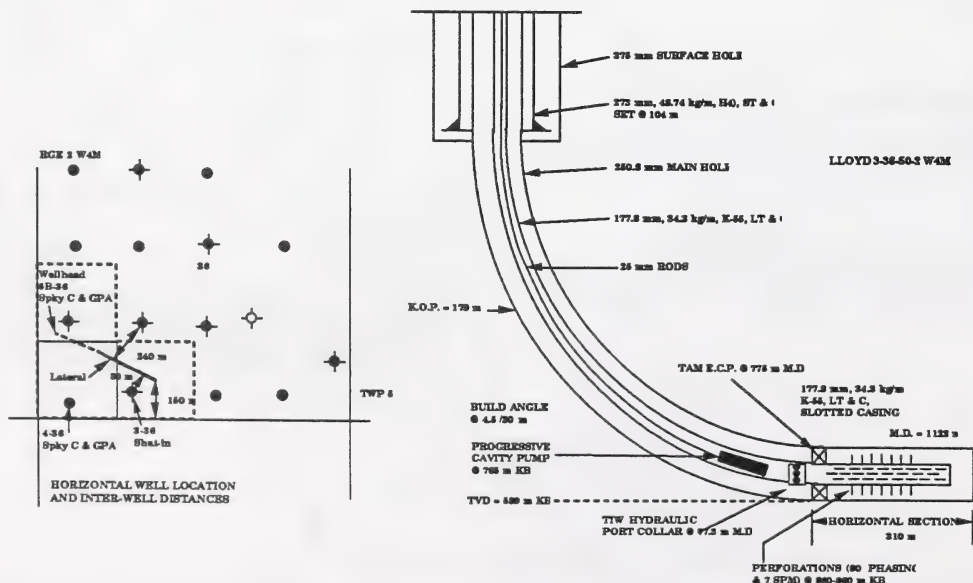
Oil Gravity at Reservoir Temp. 967 kg/m³

Primary Vertical

Production Rate 5.0 m³/well/day

Source: Pilot Operator

COMMENTS: Horizontal well was completed in the middle Sparky which has only 6.0 m net pay. Because of completion problems only 200 m out of the total horizontal section of 300 m is open to the formation.



Norcen Energy Resources Ltd.

Provost (BODO)

LOCATION

LSD: 5 Section: 20 Township: 37 Range: 1 W4M

PARTNERS:

Norcen Energy Resources Ltd.
Canadian Occidental Petroleum Ltd.
Murphy Oil Company Ltd.
CS Resources Limited
AOSTRA

PROCESS: Cyclic Steam Stimulation followed by Steamflood.

COST: Capital - \$14 MM
Operating - \$2.5 MM/Yr.

START-UP: February 1985

TERMINATION: December, 1992

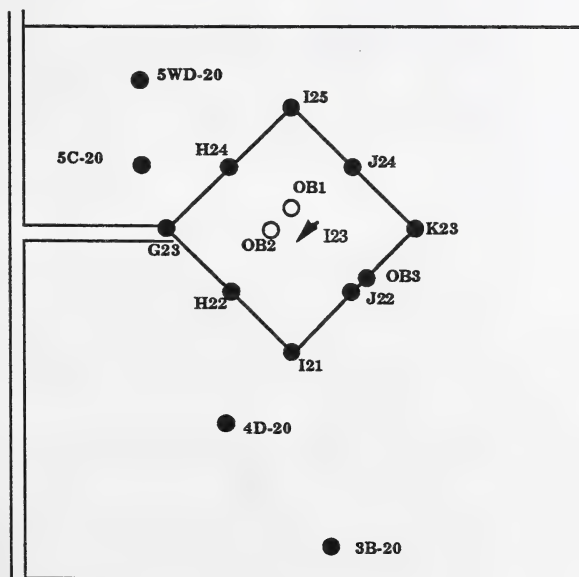
DESCRIPTION

PILOT AREA: 8 ha

WELL PATTERN: Single Inverted 9-Spot Pattern.

NO. OF WELLS:

Injection	1
Production	8
Observation	3



FACILITIES

STEAM GENERATOR(S): one - 26 GJ/hr steam generator

ARTIFICIAL LIFT METHODS: Five HEP Pumping Units and three Le Grand 456 Conventional Pumping Unit.

TREATER TYPE: Complete tank farm and battery with distillation/evaporation type treater.

TRANSPORT: Pipeline to Sales

RESERVOIR

Geological Formation: McLaren Sand of the Upper Mannville Group

Depth to Top of Formation: 720 m.KB

Reservoir Thickness:
net: 15 m
gross: up to 24 m

Original Temperature: 27°C

Original Pressure: 5450 kPa

Average Horizontal Permeability: 1000-5000 md

Average Porosity: 30%

Average Water Saturation S_w : 20%

Average Oil Saturation S_o : 80%

Oil Viscosity at Reservoir Temp. 2300 mPa.s

Oil Gravity at Reservoir Temp. 979 Kg/m³

Primary Production Rates: 4-5 m³/well/day
Source: Pilot Operator

PanCanadian Petroleum Ltd.

Countess B

LOCATION

Section: 16 Township: 29 Range: 16 W4M

PARTNERS:

PanCanadian Petroleum Ltd.	50%
LL&E	50%
Relative to Licensing Revenue:	
PanCanadian Petroleum Ltd.	45%
LL&E	45%
AOSTRA	10%

ORIGINAL PILOT PROCESS: Combination Dry Combustion and Waterflood

COST: Capital - \$4,000,000 - Dec. 31, 1999
Operating - \$5,760,000- Dec. 31,1990

START-UP: December 1982

TERMINATION: 1990 (air injection only) on original pilot only

EXPANSION PROJECT

PROCESS: Combination Wet Combustion and Waterflood.

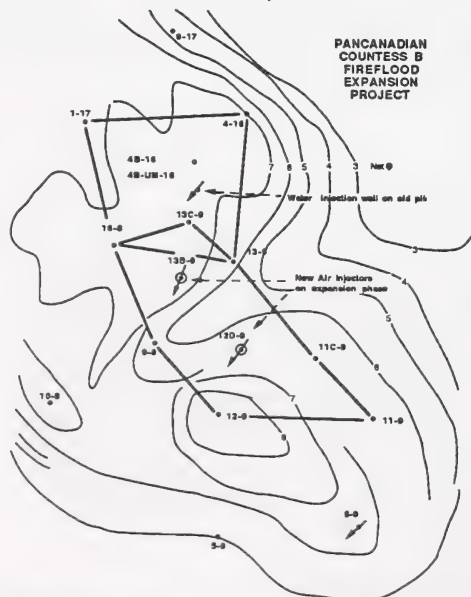
COST: Capital \$1,000,000

START-UP: December 1990

TERMINATION: Expected 1996

DESCRIPTION

PILOT AREA: original: 16.3 ha
2 additional patterns: 30 ha



WELL PATTERN: Inverted 5-Spot

NO. OF WELLS: (Total Project)

Injection Water/Air	1/2
Production	9
Post Combustion Core Well	1

FACILITIES

COMPRESSOR(S): 2 boosters and one main air compressor - Capacity 56,600 m³/d @ 24.1 MPa
ARTIFICIAL LIFT METHODS: Conventional artificial lift and Electrical Submersible pumps.

TREATER TYPE: Horizontal Murdoch HOWG

STORAGE FACILITIES: Oil Production and Shipping Tanks.

TRANSPORT: LACT, BRPL

RESERVOIR

Geological Horizon: Countess Upper Mannville B

Depth to Top of Formation: 1083 m.KB

Reservoir Thickness:

net: 5.8-10.4 m

Original Temperature: 37°C

Original Pressure: 10,000 kPa

Average Horizontal Permeability: 800 md

Average Porosity: 25%

Average Water Saturation S_w 50%

Average Oil Saturation S_o 50% pore volume

Oil Viscosity at Reservoir Temp. 6 mPa.s

Oil Gravity at Reservoir Temp. 887 Kg/m³

Primary Production Rates: 12 m³/well/day

Source: Pilot Operator

COMMENTS: Water injection for heat scavenging started in post combustion core well 4B-UM-16 November 14, 1990. Two additional patterns and 2 new air injectors (13B-9 and 12D-9 added to the south. Also four waterflood producers were converted to fireflood operation in December 1990.

Typical combustion gas composition for total project is as follows

Nitrogen	=	74.0%
Carbon Dioxide	=	9.4%
Carbon Monoxide	=	0.3%
Oxygen	=	0.3%

Technically successful.

Petro-Canada Resources

PCEJ

LOCATION

LSD: 1 Section: 34 Township: 84 Range: 11 W4M

PARTNERS:

Petro-Canada Resources	25%
Canadian Occidental Petroleum Ltd.	25%
Esso Resources Canada Ltd.	25%
Japan Canada Oil Sands	25%

PROCESS: Thermal recovery Cyclic Steam

COST: \$44.15M

START-UP: May 1990

TERMINATION: March 31, 1992

DESCRIPTION

13 well pilot

PILOT AREA: 20 hectares - 1.5 hectare/well

WELL PATTERN: Staggered Line Drive (They also form an enclosed 7 spot pattern)

WELL SPACING: 132 m (1.5 hectares)

NO. OF WELLS: 13 (12 slant and 1 vertical)

5 observation wells

FACILITIES

STEAM GENERATOR(S): Two TIW 22000 kg/hr of 80% quality steam

ARTIFICIAL LIFT METHODS: Insert bottomhole pump, Corod and 160-173-86 conventional pump jack

TREATER TYPE: HTI Electrostatic 10' x 60' x 75 psig

FWKO 10' x 30' x 90 psig

STORAGE FACILITIES:

Production Tank - One - 64 m³

Sales Oil tanks - Two - 64 m³

Produced water skim tank - One - 400 m³

Produced water storage tank - One - 120 m³

Recycle tank - One - 120 m³

TRANSPORT: Sales oil - Trucking - Syncrude Plant

RESERVOIR

Geological Horizon: McMurray

Depth to Top of Formation: 280 m.KB

Reservoir Thickness:

net: 20 m

gross: 35 m

Original Temperature: 10°C

Original Pressure: 2200 kPa

Average Horizontal Permeability: 1500 md

Average Porosity: 33%

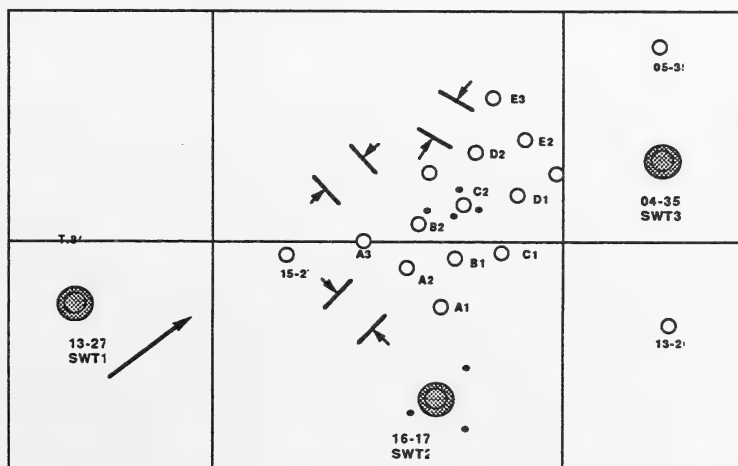
Average Water Saturation S_w : 15%

Average Oil Saturation S_o : 85% pore volume

Oil Viscosity at Reservoir Temp. 1,000,000 cp

Oil Gravity at Reservoir Temp. 1008 Kg/m³

Source: Pilot Operator



Pinnacle Resources

Leduc Woodbend

LOCATION

LSD: 3 Section:20 Township: 49 Range: 25 W4M

PARTNERS:

Pinnacle Resources 100%

COST: \$1,200 M

START-UP: Summer 1992

TERMINATION: March, 1992

DESCRIPTION

Drill a 600 m horizontal well into the abandoned Leduc Woodbend D2B pool to increase pool recovery.

WELL PATTERN: SW/4-20-49-25W4

WELL SPACING: 64 hectare

NO. OF WELLS: one

RESERVOIR

Geological Horizon:	Nisku
Depth to Top of Formation:	1600 m.KB
Reservoir Thickness:	
net:	6-18 m
gross:	45 m
Original Temperature:	60°C
Original Pressure:	12650 kPa
Average Horizontal Permeability:	4 md
Average Porosity:	0.05%
Average Water Saturation S_w	34%
Average Oil Saturation S_o	66% pore volume
Oil Gravity at Reservoir Temp.	834 Kg/m ³
Primary Prod. Rates:	8.0 m ³ /well/day
Source:	Pilot Operator

FACILITIES

ARTIFICIAL LIFT METHODS: Conventional pumping unit.

STORAGE FACILITIES: Oil Storage Tanks

TRANSPORT: Tank Truck

Renaissance Energy Ltd.

Horizontal Well

LOCATION

LSD: 11B Section: 21 Township: 20 Range: 8
W4M

PARTNERS:

Renaissance 100%

PROCESS: Horizontal Well

COST: Approximately \$500,000

START-UP: June 1989

TERMINATION: January 31, 1994

DESCRIPTION

300 m long horizontal well drilled within 4 m of the top of the Glauco sand, and approximately 12 m above oil/water contact

WELL PATTERN: Standard 10 acre spacing

WELL SPACING: 10 acres

NO. OF WELLS: Two horizontal wells both approximately 300 m long. One 10 acre producer in 11B-21

FACILITIES

ARTIFICIAL LIFT METHODS: High volume rotary pumps

TREATMENT TYPE: Well is tied into Renaissance Battery at 6-21-20-8 W4M

STORAGE FACILITIES: Standard conventional oil storage and treating facilities

TRANSPORT: Tied into Bow Island Pipeline system

RESERVOIR

Geological Horizon: Upper Mannville
Depth to Top of Formation: 918.6 m.KB

Reservoir Thickness:
net: 16.0 m
gross: 35.0 m

Original Temperature: 28°C

Original Pressure: 10410 kPa

Average Horizontal Permeability: 4.0D

Average Porosity: 25%

Average Water Saturation S_w : 25%

Average Oil Saturation S_o : 75% pore volume

Oil Viscosity at Reservoir Temp.: 1100 mPa.s

Oil Gravity at Reservoir Temp.: 979 Kg/m³

Primary Production Rates: 50.0 m³/well/day
Source: Pilot Operator

Rife Resources Ltd.

Horizontal Well.

LOCATION

LSD: 9 Section: 15 Township: 63 Range: 25 W5M
and
Section: 2 Township: 63 Range: 25 W5M

PARTNERS:

Rife Resources 100%

COST: \$2 MM/well

TERMINATION: Suspended

DESCRIPTION

Drill horizontal well for oil production from vertically fractured Nordeg formation.

PILOT AREA: Simonette

WELL SPACING: 1/section initially

NO. OF WELLS: Two

RESERVOIR

Geological Horizon: Nordeg
Depth to Top of Formation: 2385 m.KB

Reservoir Thickness:
net: 25 m

gross: 25 m

Original Temperature: 88°C

Original Pressure: 29 mPa

Average Water Saturation S_w 0%

Average Oil Saturation S_o 100% pore volume

Oil Viscosity at Reservoir Temp. 7 mPa.s

Oil Gravity at Reservoir Temp. 900 Kg/m³

Primary Prod. Rates: 60 m³/well/day

Source: Pilot Operator

COMMENT: Due to lack of funding project is indefinitely suspended.

FACILITIES

ARTIFICIAL LIFT METHODS: Pump and rods

Sceptre Resources Limited

Grand Forks Horizontal Well

LOCATION

LSD: 12B Section 18 Township: 12 Range: 13 W4M

PARTNERS:

Oakwood Petroleums	87.5%
Murphy Oil	12.5%

PROCESS: Horizontal drilling

COST: \$1,000,000 (includes well drilling and related pumping/surface facilities)

START-UP: March, 1991

TERMINATION: February 1993

DESCRIPTION

Drilled horizontal well within mature Grand Forks Lower Mannville K-V Pool to access bypassed reserves.

WELL SPACING: 16 ha

NO. OF WELLS: One horizontal well

FACILITIES

ARTIFICIAL LIFT METHODS: High volume lift using electrical submersible pump

TRANSPORT: Bow River Pipelines

RESERVOIR

Geological Horizon:	Lower Mannville
Depth to Top of Formation:	900 m.KB
Reservoir Thickness:	
net:	11 m
gross:	15 m
Original Temperature:	32°C
Original Pressure:	10,500 kPa
Average Horizontal Permeability:	500-1000 md
Average Porosity:	25%
Average Water Saturation S_w	25%
Average Oil Saturation S_o	75% pore volume
Oil Viscosity at Reservoir Temp.	17 mPa.s
Oil Gravity at Reservoir Temp.	898 Kg/m ³
Source:	Pilot Operator

COMMENTS: The drilling of this horizontal well was undertaken in an attempt to access reserves within the uppermost portion of this channel sand oil pool. Reduced water coning was another reason for attempting to access these bypassed reserves with a horizontal well. Production to date has been wetter than anticipated from the study but operator remains encouraged that economical reserves enhancement will result.

Total Petroleum Canada Ltd.

Horizontal Well

LOCATION

LSD: 10 Section: 36 Township:81 Range: 11 W6M

PARTNERS:

Total	33%
Suncor	33%
Murphy	33%

PROCESS: Horizontal well

COST: \$1,150,000

START-UP: February 1992

TERMINATION: December 1993

DESCRIPTION

Horizontal producing well

PILOT AREA: Bonanza

NO. OF WELLS: One

RESERVOIR

Geological Horizon:	Doig
Depth to Top of Formation:	1497.4 m.KB
Reservoir Thickness:	
net:	13 m
gross:	13 m
Original Temperature:	57°C
Original Pressure:	13,400kPa
Average Horizontal Permeability:	1-4 md
Average Porosity:	12%
Average Water Saturation S_w	25%
Average Oil Saturation S_o	75% pore volume
Oil Viscosity at Reservoir Temp.	3.2 mPa.s
Oil Gravity at Reservoir Temp.	850 Kg/m ³
Primary Prod. Rates:	Confidential
Source:	Pilot Operator

FACILITIES

TRANSPORT: Trucked crude (produced)

Vikor Resources Ltd.

Joffre - Phase II

LOCATION

Section: 24,25,26,34 & 35 Township: 38

Range: 26 W4M

Section: 19 & 30 Township: 38 Range: 25 W4M

PARTNERS:

Vikor Resources Ltd.

45%

Unit Partners

35%

AOSTRA

20%

PROCESS: CO₂ Miscible Flood

COST: Capital - \$6,500,000

START-UP: July 1985 - First CO₂ Injection.

Expanded in 1988.

TERMINATION: 1995*

DESCRIPTION

PILOT AREA: About 450 ha

WELL PATTERN: Two Truncated Inverted 9-Spots

NO. OF WELLS:

Injection	(water) 1
	(CO ₂ + water) 2

Production	11
------------	----

Observation	0
-------------	---

* Phase II has now been expanded and all facilities and wells have been incorporated into the commercial scheme in accordance with ERCB Approval #6636.

FACILITIES

Two CO₂ booster compressors - 75,000 m³/d
atmos to 1.0 MPa and injection - 115,000 m³/d
1.0 to 11 MPa

ARTIFICIAL LIFT METHODS: Conventional
subsurface pumps and submersible centrifugal
pumps.

TREATER TYPE: 3-phase test and group
separators.

TRANSPORT: Crude sales through (LACT) to Gulf's
Pipeline

RESERVOIR

Geological Horizon: Joffre Viking A Sand

Depth to Top of Formation: 1475 m.KB

Reservoir Thickness:
net: 3 m

gross: 4.5 m

Original Temperature: 56°C

Original Pressure: 7760 kPa

Average Horizontal Permeability: 500 md

Average Porosity: 13%

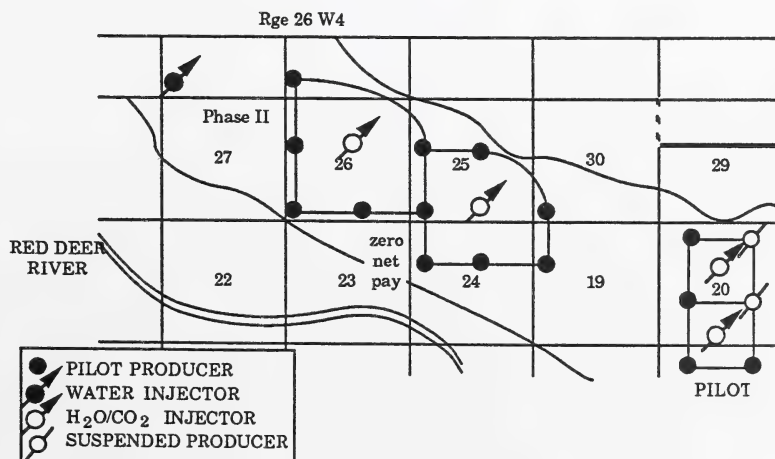
Initial Water Saturation: 30%

Oil Saturation After Waterflood: Approx. 40%

Oil Viscosity at Reservoir Temp. 1-2 mPa.s

Oil Gravity at Reservoir Temp. 813 Kg/m³

Primary Production Rates: 7 m³/well/day
Source: AOSTRA



APPENDIX

RECENTLY TERMINATED PILOT PROJECTS

Alberta Energy Company

Ipiatik Lake Phase A

LOCATION

Section: 1 Township: 73 Range: 6 W4M

PARTNERS:

Alberta Energy Company Limited	60%
Amoco Canada Petroleum Company Ltd.	30%
Deminex (Canada) Limited	10%

PROCESS: Cyclic Steam Stimulation

COST: Capital - \$24,000,000 wells/facility/roads

START-UP: Spring 1984

TERMINATION: December 3, 1987

DESCRIPTION

WELL PATTERN: Skewed 7-Spot

WELL SPACING: 1.46 ha/2.44 ha

NO. OF WELLS:

Injection/Production	11
Observation	2

(monitoring temperature via thermocouples)

FACILITIES

STEAM GENERATOR(S): one - 53 GJ/hr steam generator

ARTIFICIAL LIFT METHODS: Standard Pump Jacks

TREATER TYPE: Conventional Electrostatic Treater

STORAGE FACILITIES: Field Tanks

TRANSPORT: Rail Transport

RESERVOIR

Geological Horizon: Wabiskaw

Depth to Top of Formation: 450 m.KB

Reservoir Thickness:

net:	25 m
gross:	29 m

Original Temperature: 16°C

Original Pressure: 2200 kPa

Average Horizontal Permeability: 800 md

Average Porosity: 27%

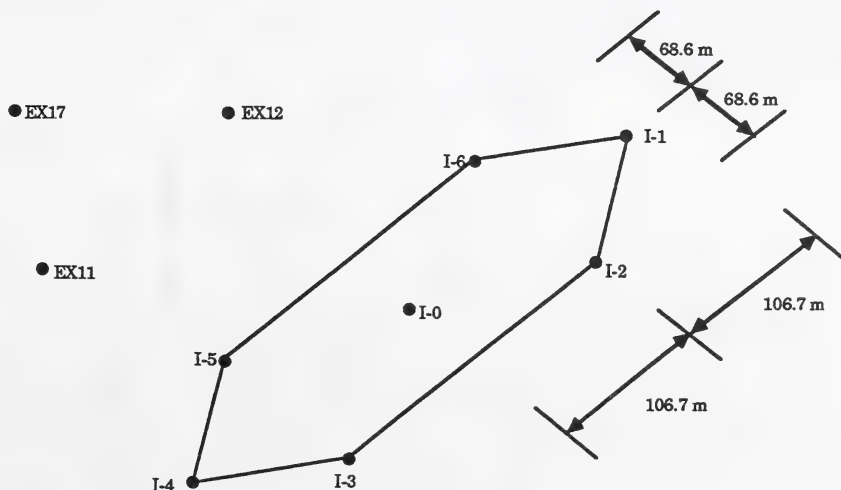
Average Water Saturation S_w : 20%

Average Oil Saturation S_o : 80% pore volume

Oil Viscosity at Reservoir Temp. 45,000 mPa.s

Oil Gravity at Reservoir Temp. 993 Kg/m³

Source: Pilot Operator



Alberta Energy Company

Ipiatik Lake Phase B

LOCATION

Section: 2 Township: 73 Range: 6 W4M

PARTNERS:

Alberta Energy Company Limited	60%
Amoco Canada Petroleum Company Ltd.	30%
Deminex (Canada) Limited	10%

PROCESS: Cyclic Steam Stimulation

START-UP: January 1987

TERMINATION: Suspended January 1, 1990

DESCRIPTION

PILOT AREA: 3.7 ha

WELL PATTERN: Regular 7-Spot

WELL SPACING: 2.43 ha

NO. OF WELLS:

Injection/Production

7

FACILITIES

STEAM GENERATOR(S): one - 53 GJ/hr steam generator

ARTIFICIAL LIFT METHODS: Standard Pump Jacks

TREATER TYPE: Conventional Electrostatic Treater

STORAGE FACILITIES: Field Tanks

TRANSPORT: Rail Transport

RESERVOIR

Geological Horizon:	Wabiskaw
---------------------	----------

Depth to Top of Formation:	450 m.KB
----------------------------	----------

Reservoir Thickness:	
net:	25 m
gross:	29 m

Original Temperature:	16°C
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Original Pressure:	2200 kPa
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Average Horizontal Permeability:	800 md
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Average Porosity:	27%
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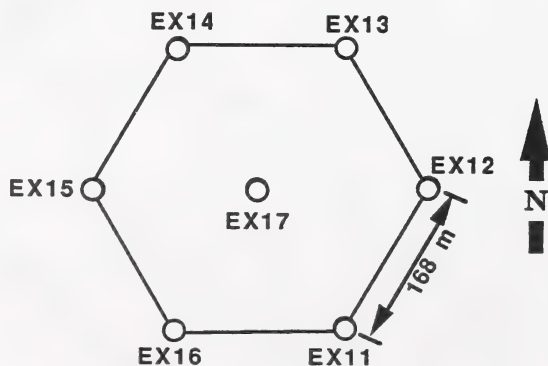
Average Water Saturation S_w	20%
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Average Oil Saturation S_o	80% pore volume
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Oil Viscosity at Reservoir Temp.	45,000 mPa.s
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Oil Gravity at Reservoir Temp.	993 kg/m ³
--------------------------------	-----------------------

Source:	Pilot Operator
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Alberta Energy Company

Suffield I

LOCATION

LSD: 4 Section: 10 Township: 20 Range: 8 W4M

PARTNERS:

AOSTRA	50%
Alberta Energy Company Ltd.	33.33%
Westcoast Petroleum Company Ltd.	16.66%

PROCESS: Wet Combustion

COST: Capital - \$8,989,000 (to Dec. 31/88)
Operating - \$7,481,000 (to Dec. 31/88)

START-UP: 1980

TERMINATION: February 1987, termination of wet combustion process. December 1988, termination of blowdown phase.

DESCRIPTION

PILOT AREA: 2 ha

WELL PATTERN: Inverted 5-Spot

WELL SPACING: 1 ha

NO. OF WELLS:

Injection	1	suspended
Production	4	2 - suspended
Temperature monitoring		
Observation	3	suspended

FACILITIES

One air compressor - Capacity - 58,000 m³/d @ 15.9 MPa

ARTIFICIAL LIFT METHODS: Conventional Beam Pump

TREATER TYPE: Pressure Heater-Treater

STORAGE FACILITIES: Oil - 620 m³, Emulsion - 400 m³, Water - 620 m³

TRANSPORT: Truck

RESERVOIR

Geological Horizon: Glauconitic Sandstone

Depth to Top of Formation: 900 m.KB

Reservoir Thickness:
net: 20 m
gross: 60 m

Original Temperature: 32°C

Original Pressure: 10,275 kPa

Average Horizontal Permeability: 480 md

Average Porosity: 27%

Average Water Saturation S_w : 25%

Average Oil Saturation S_o : 75% pore volume

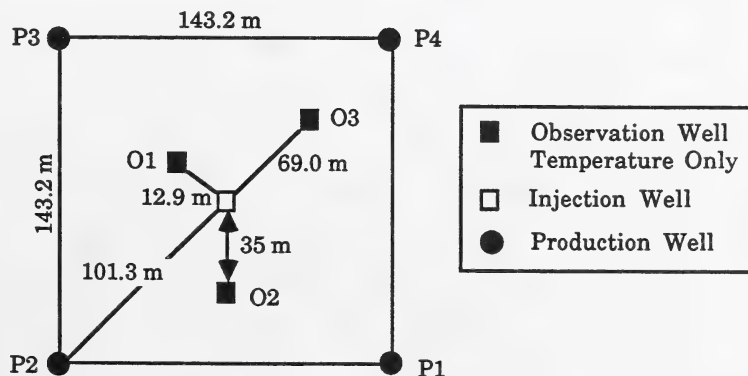
Oil Viscosity at Reservoir Temp. 850-5000 mPa.s

Oil Gravity at Reservoir Temp. 974-992 Kg/m³

Primary Production Rates: 1-10 m³/well/day

Source: Pilot Operator

COMMENTS: Phase A of Pilot Project completed December 31, 1986. Proceeding with Phase B of project which includes cyclic gas injection scheme, and blowdown of Phase A production wells which is reported separately.



Alberta Energy Company

Suffield II

LOCATION

LSD: 11 Section: 34 Township: 19 Range: 8 W4M

PARTNERS:

Alberta Energy Company Limited
Westcoast Petroleum Ltd.
AOSTRA

PROCESS: Gas Injection Slug

START-UP: September 1987

TERMINATION: March 1988

DESCRIPTION

PILOT AREA: 2.86 ha

WELL PATTERN: Inverted 7-Spot

WELL SPACING: 0.9 ha/well

NO. OF WELLS:

Injection (Common Wellbore)

Production

1
6

FACILITIES

GAS COMPRESSOR(S): one; rental only,
Capacity: 14,000 (m³/d @ 13.5 MPa)

ARTIFICIAL LIFT METHODS: Conventional Beam
Pumpjack

TREATER TYPE: Pressure Heater Treater with Colt
Evaporator Polisher

TRANSPORT: Pipeline

RESERVOIR

Geological Horizon: Glauconite Sandstone

Depth to Top of Formation: 899.5 m.KB

Reservoir Thickness:

net: 32 m

gross: 51 m

Original Temperature: 33°C

Original Pressure: 10515 kPa

Avg. Horizontal Perm.: 500-1000 md

Avg. Porosity: 27%

Avg. Water Saturation S_w 25%

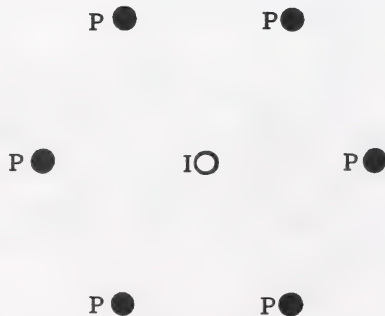
Avg. Oil Saturation S_o 75 pore vol.

Oil Viscosity at Reservoir Temp. 395 mPa.s

Oil Gravity at Reservoir Temp. 970-975Kg/m³

Primary Production Rates: 1-15 m³/well/day

Source: Pilot Operator



Alberta Energy Company

Suffield Hot Water Flood

LOCATION

LSD: 12 Section: 3 Township: 20 Range: 8 W4M

PARTNERS:

Alberta Energy Company Limited
Westcoast Petroleum Ltd.
AOSTRA

PROCESS: Hot Water Flood

COST: Capital - \$620,000
Operating - \$1,124,000

START-UP: 1988

TERMINATION: 1990

DESCRIPTION

PILOT AREA: 0.5 ha

WELL PATTERN: Inverted 4-Spot

WELL SPACING: 65 m

NO. OF WELLS:

Injection
Production

1
3

FACILITIES

WATER HEATER: Indirect fired line heater (salt bath)

ARTIFICIAL LIFT METHODS: Beam Pump

TREATER TYPE: Produced to Jenner Battery

STORAGE FACILITIES: Central Battery

TRANSPORT: Pipeline

RESERVOIR

Geological Horizon: Glauconite Sandstone

Depth to Top of Formation: 900 m.KB

Reservoir Thickness:

net: 33 m

gross: 60 m

Original Temperature: 32°C

Original Pressure: 10275 kPa

Average Horizontal Permeability: 500-1000 md

Average Porosity: 27%

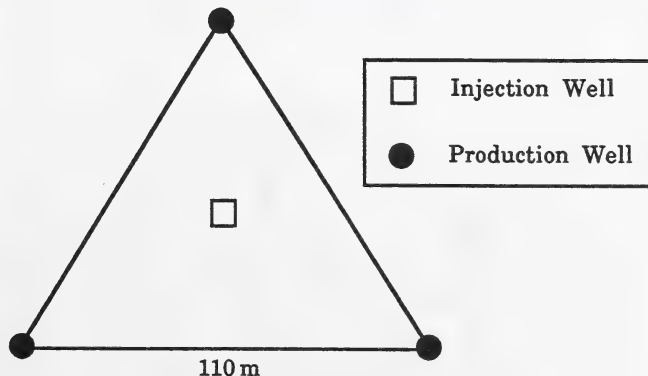
Average Water Saturation S_w : 25%

Average Oil Saturation S_o : 75% pore vol.

Oil Viscosity at Reservoir Temp. 400 mPa.s

Oil Gravity at Reservoir Temp. 970-975 Kg/m³

Primary Production Rates: 1-15 m³/well/day
Source: Pilot Operator



Amoco Canada Petroleum Company Ltd.

Atlee Buffalo

LOCATION

Section: Township: Range: 5&6 W4M

PARTNERS:

Amoco Canada Petroleum Company Ltd. 100%

PROCESS: Combination Thermal Drive

COST: Capital - \$2.8 Million
Operating - \$1.5 Million for 1985

START-UP: July 1983

TERMINATION: November 1987

DESCRIPTION

PILOT AREA: 240 ha

WELL PATTERN: Two irregular inverted 9-Spot patterns

WELL SPACING: 15 ha/well

NO. OF WELLS:

Injection	2
Production	14
Observation	0

FACILITIES

One - 98,600 m³/d @ 12.4 MPa air compressor

ARTIFICIAL LIFT METHODS: Beam Pumps and Progressive Cavity Pumps

TREATER TYPE: Pressure treater

STORAGE FACILITIES: Oil - 1000 m³

Water - 160 m³, Emulsion - 160 m³

TRANSPORT: Truck

RESERVOIR

Geological Horizon: Glauconite

Depth to Top of Formation: 915 m.KB

Reservoir Thickness: net: 3.7 m

Original Temperature: 30.6°C

Original Pressure: 10300 kPa

Average Horizontal Permeability: 1800 md

Average Porosity: 24%

Average Water Saturation S_w : 34%

Average Oil Saturation S_o : 66% pore vol.

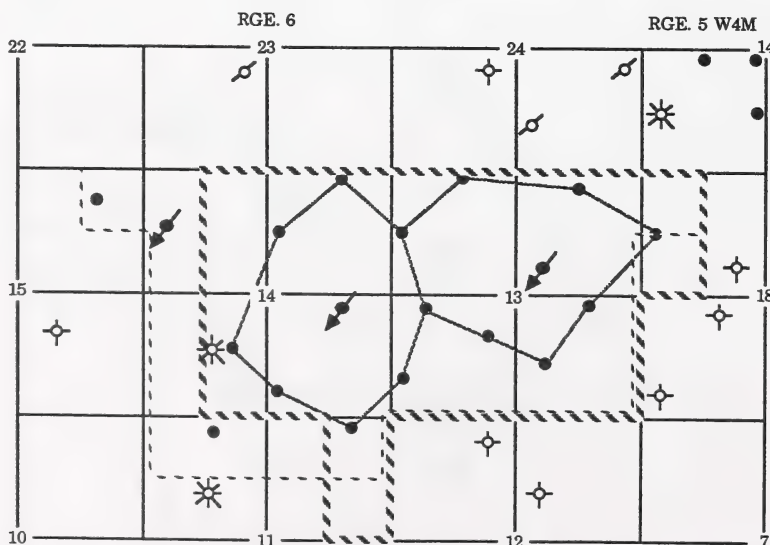
Oil Viscosity at Reservoir Temp.: 310 mPa.s

Oil Gravity at Reservoir Temp.: 965 Kg/m³

Primary Production Rates: 3.2 m³/well/day

Source: Pilot Operator

COMMENTS: The project has been shut in due to low prices since November 1987. There are no plans to re-start the air injection.



Amoco Canada Petroleum Company Ltd.

Gregoire Lake - Phase A

LOCATION

LSD: 5 Section: 2 Township: 86 Range: 7 W4M

PARTNERS:

AOSTRA	75%
Amoco Canada Petroleum Company Ltd.	12.5%
Petro-Canada Resources	12.5%

PROCESS: Steamflood with additives (CO_2 and/or Naphtha)

COST: Capital - \$7,460,000
Operating - \$15,275,000 to term

START-UP: May 1985

TERMINATED: December 1989

DESCRIPTION

PILOT AREA: 0.28 ha

WELL PATTERN: Inverted 4-Spot

WELL SPACING: S/B 0.19 ha/well

NO. OF WELLS:

Injection	1
Production	3
Observation	3

FACILITIES

STEAM GENERATOR(S): one - 26.4 GJ/hr

ARTIFICIAL LIFT METHODS: Conventional Beam Pump

TREATER TYPE: Atmospheric tankage plus diluent

STORAGE FACILITIES: Bitumen/diluent - 400 m³.

Emulsion - 400 m³, Water - 400 m³

TRANSPORT: Truck

RESERVOIR

Geological Horizon:

McMurray

Depth to Top of Formation:

1

m.KB

Reservoir Thickness:

net:

4

m

gross:

4

m

Original Temperature:

10°C

Original Pressure:

5 3

kPa

Average Porosity:

36.4%

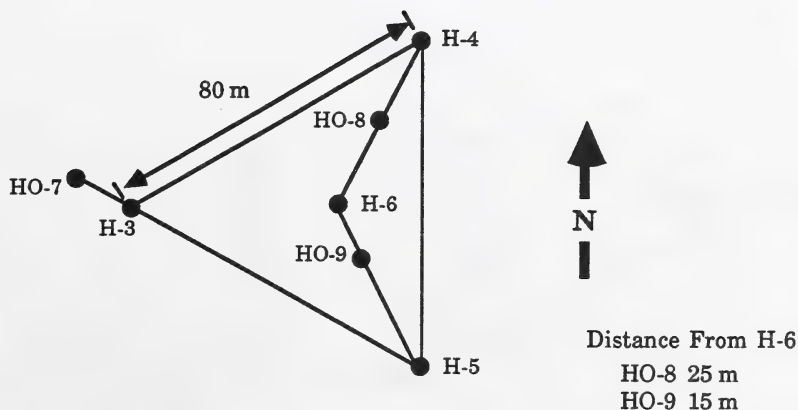
Average Water Saturation S_w

25%

Average Oil Saturation S_o

75% p

vol.



Amoco Canada Petroleum Company Ltd.

Gregoire Lake - Phase B

LOCATION

LSD: 5 Section: 2 Township: 86 Range: 7 W4M

PARTNERS:

AOSTRA	85.71%
Amoco Canada Petroleum Company Ltd.	14.29%

PROCESS: Steamflood with additives (Surfactant, natural gas, air and pressure cycling)

COST: Capital - nil
Operating - \$3,200,000 to December 31, 1991

START-UP: January 1, 1990

TERMINATED: July 18, 1991

DESCRIPTION

PILOT AREA: 0.28 ha

WELL PATTERN: Inverted 4-Spot

WELL SPACING: S/B 0.19 ha/well

NO. OF WELLS:

Injection	1
Production	3
Observation	3

FACILITIES

STEAM GENERATOR(S): one - 26.4 GJ/hr

ARTIFICIAL LIFT METHODS: Conventional Beam Pump

TREATER TYPE: Atmospheric tankage plus diluent

STORAGE FACILITIES: Bitumen/Diluent - 400 m³

Emulsion - 400 m³, Water - 400 m³

TRANSPORT: Truck

RESERVOIR

Geological Horizon: McMurray

Depth to Top of Formation: 187 m.KB

Reservoir Thickness:

net: 41 m

gross: 47 m

Original Temperature: 10°C

Original Pressure: 531 kPa

Average Porosity: 36.4%

Average Water Saturation S_w 25%

Average Oil Saturation S_o 75% pore vol.

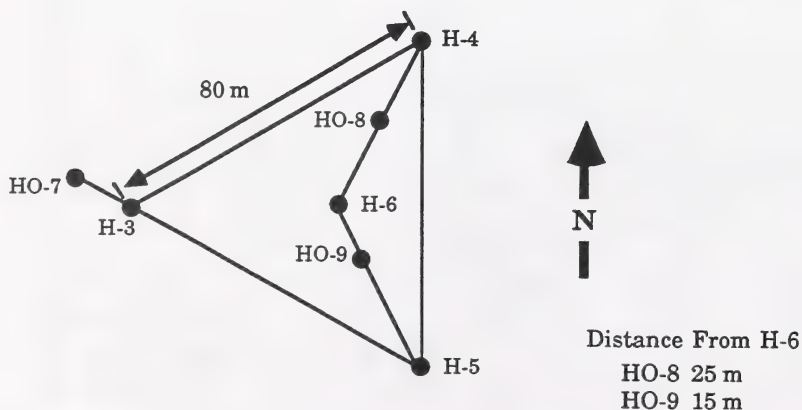
Oil Viscosity at Reservoir Temp. 850,000 mPa.s

Oil Gravity at Reservoir Temp. 1018 Kg/m³

Source: Pilot Operator

COMMENTS:

Phase B operations initiated immediately following termination of Phase A.



Amoco Canada Petroleum Company Ltd.

Soars Lake (Beaverdam)

LOCATION

Section: 24 & 25 Township: 59 Range: 2 W4M

Section: 19 Township: 59 Range: 1 W4M

PARTNERS:

Amoco Canada Petroleum Company Ltd. 100%

PROCESS: Primary Production

START-UP: June 1, 1985

SUSPENDED: May, 1986

REACTIVATED: 1988

DESCRIPTION

Single Well Cyclic Steam Stimulation Program

WELL SPACING: 64.75 ha

NO. OF WELLS:

Injection/Production 18

FACILITIES

STEAM GENERATOR(S): one 7.3 MW portable steam generator

ARTIFICIAL LIFT METHODS: Beam Pump and Progressive Cavity Pump

STORAGE FACILITIES: 120 m³ Tanks

RESERVOIR

Geological Horizon: Sparky

Depth to Top of Formation: 450 m.KB

Reservoir Thickness:

net: 10 m

gross: 20 m

Original Temperature: 22°C

Original Pressure: 2800 kPa

Average Horizontal Permeability: 1200 md

Average Porosity: 30%

Average Water Saturation S_w 30%

Average Oil Saturation S_o 70% pore vol.

Oil Viscosity at Reservoir Temp. 20,000 mPa.s

Oil Gravity at Reservoir Temp. 985 Kg/m³

Primary Production Rates: 2.0 m³/well/day

Source: Pilot Operator

COMMENTS

This project was suspended in May, 1986 due to low heavy oil prices and reactivated in 1988.

Currently attempting to evaluate primary production potential of the area.

Amoco Canada Petroleum Company Ltd.

Soars Lake (Beaverdam) (II)

LOCATION

LSD 14 Section: 19 Township: 59 Range: 1 W4M

PARTNERS:

Amoco Canada Petroleum Company Ltd. 100%

PROCESS: Steam Stimulation

START-UP: June, 1988

TERMINATION: June, 1990

DESCRIPTION

Single Well Cyclic Steam Stimulation Program

WELL SPACING: 4.047 ha

NO. OF WELLS:

Injection/Production

16

Observation

1

FACILITIES

STEAM GENERATOR(S): two 7.3 MW steam generators

ARTIFICIAL LIFT METHODS: HEP

STORAGE FACILITIES: Pressurized Treater, Treated Oil Trucked to Sales

RESERVOIR

Geological Horizon: Sparky

Depth to Top of Formation: 450 m.KB

Reservoir Thickness:

net: 10 m

gross: 20 m

Original Temperature: 22°C

Original Pressure: 2800 kPa

Average Horizontal Permeability: 1200 md

Average Porosity: 30%

Average Water Saturation S_w : 30%

Average Oil Saturation S_o : 70% pore vol.

Oil Viscosity at Reservoir Temp. 20,000 mPa.s

Oil Gravity at Reservoir Temp. 985 Kg/m³

Primary Production Rates: 2.0 m³/well/day

Source: Pilot Operator

COMMENTS

Steaming above fracture pressure began in June, 1988. Well-to-well interference and sand production problems were initially severe. Steaming strategy and completions were revised in 1989 to reduce these problems. Additional data gathered in 1989 indicated that steaming above parting pressure was not effective. Project is terminated with no intent of re-starting.

Bow Valley Industries Ltd.

Marie (Cold Lake)

LOCATION

LSD: 7 Section: 14 Township: 65 Range: 2 W4M

PARTNERS:

AOSTRA	50%
Bow Valley Industries Ltd.	50%

These are current participating interests. Agreements between the parties provide for changes in interests as the project progresses through different phases.

PROCESS: Cyclic, frac assisted matrix injection scheme initially utilizing superheated steam, CO₂ and other chemical additives.

COST: Capital: \$10,205,000
Operating: \$17,500,000

START-UP: January 15, 1985 (commencement of cyclic steam) Phase A, January 1987 for Phase AX

TERMINATION: December 31, 1990

DESCRIPTION

PILOT AREA: 8.8 ha for 2 patterns

WELL PATTERN: Skewed 7-Spot

WELL SPACING:

Initial Pilot: 0.9 ha spacing

Second Phase: 1.8 ha spacing

NO. OF WELLS:

Injection/Production

Observation

16
3

FACILITIES

STEAM GENERATOR(S): two - 94.78 GJ/hr

ARTIFICIAL LIFT METHODS: Rod actuated bottomhole pumps, tubing and conventional pumpjacks

TREATER TYPE: Colt dehydrator

STORAGE FACILITIES:

FWKO = 318 m³, coalescing tank - 636 m³, settling

tank = 119 m³, Sales Oil Tank - 795 m³, waste water skimmer tank - 318 m³, waste water storage tanks 476 m³

RESERVOIR

Geological Horizon:	Clearwater
Depth to Top of Formation:	420 m.KB

Reservoir Thickness:	
net:	(C-2 only) 8.5 m (C-3 only) 4.0 m
gross:	(C-2 only) 10.0 m (C-3 only) 4.0 m

Original Temperature:	11.5°C
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Original Pressure:	3450 kPa
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Average Horizontal Permeability:	2000 md
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Average Porosity:	35%
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Average Water Saturation S _w	40%
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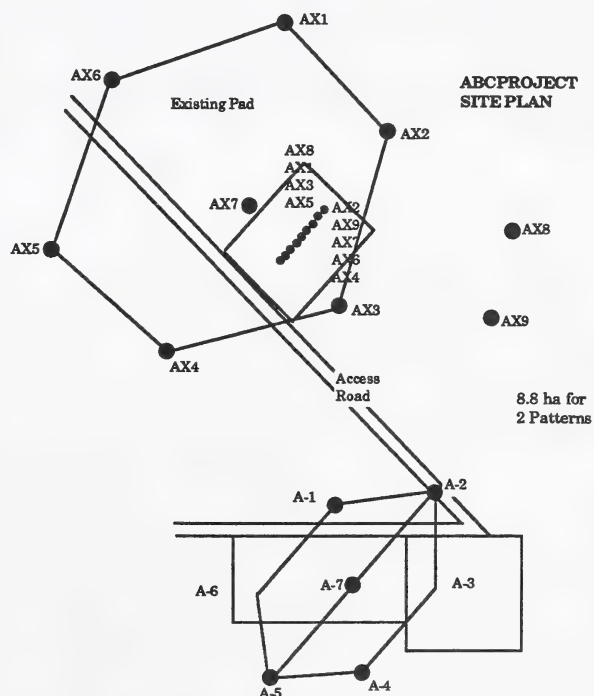
Average Oil Saturation S _o	60% pore vol.
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Oil Viscosity at Reservoir Temp.	500,000 mPa.s
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Oil Gravity at Reservoir Temp.	1000 Kg/m ³
--------------------------------	------------------------

Primary Production Rates:	1 m ³ /well/day
Source:	AOSTRA

COMMENTS: August 1, 1990 (field operations terminated).



BP Canada

Marguerite Lake Phase A

LOCATION

LSD: 8, 9, 16, 5, 12 & 13 Section: 7,9
Township: 66 Range: 5 W4M

PARTNERS:

AOSTRA	50%
BP Canada (Operator)	50%

PROCESS: Wet Combustion with O₂

COST: Capital - \$20,000,000
Operating - \$30,000,000

START-UP: June 1978

TERMINATION: April 1987

DESCRIPTION

PILOT AREA: 20 ha over 4 patterns

WELL PATTERN: Four 5-Spot patterns with subsequent in-fill drilling

WELL SPACING: Initial 2 ha spacing

NO. OF WELLS:

Test area: 3 combustion test wells (1 injector; 2 producers) Main pattern 5 injectors, 16 producers.

1 non-operational well; 12 observation wells: 12 (12 for temperature only; 2 for temperature and pressure)

FACILITIES

STEAM GENERATOR(S): two - 53 GJ/hr

ARTIFICIAL LIFT METHODS: Standard Pump Jack

TREATER TYPE: 8' x 30' Cenatco

STORAGE FACILITIES: Oil - 499 m³

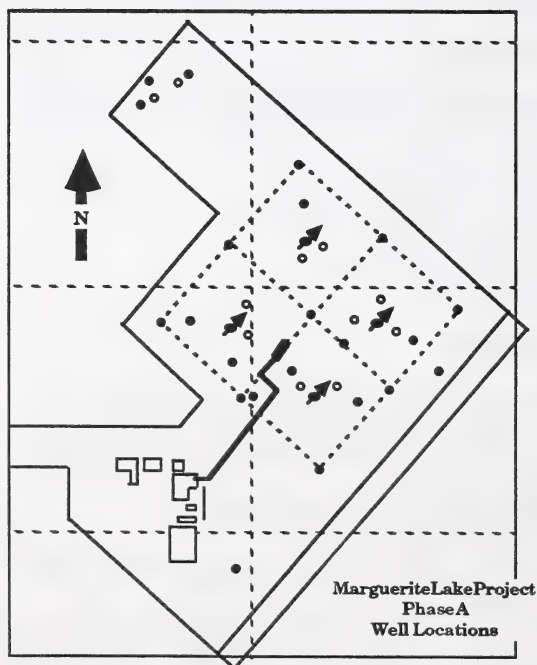
Water - 800 m³

TRANSPORT: Truck

RESERVOIR

Geological Horizon:	Clearwater
Depth to Top of Formation:	440 m.KB
Reservoir Thickness:	
net:	23 m
gross:	35.4 m
Original Temperature:	16°C
Original Pressure:	2800 kPa
Average Horizontal Permeability:	1150 md
Average Porosity:	31%
Average Water Saturation S _w	35%
Average Oil Saturation S _o	65% pore volume
Oil Viscosity at Reservoir Temp.	100,000 mPa.s
Oil Gravity at Reservoir Temp.	993 Kg/m ³
Source:	AOSTRA

COMMENTS: This project terminated April 1, 1987. New Project (BP/PCI Project Owl) started on same location with new partner.



BP Canada/Petro-Canada Resources

Project Owl

LOCATION

LSD: 8,9,16,5,12,13 Section: 7.9 Township: 66
Range: 5 W4M

PARTNERS:

Petro-Canada Resources	50%
BP Canada (Operator)	50%

PROCESS: Wet Combustion with O₂

COST: Capital - \$1,000,000
Operating - \$7,000,000

START-UP: April 1987

TERMINATION: December 1988

DESCRIPTION

PILOT AREA: 20 ha over 4 patterns

WELL PATTERN: Four 5-Spot patterns with subsequent in-fill drilling

WELL SPACING: Initial 2 ha spacing

NO. OF WELLS:

Injection (oxygen/water)	3
Production	16
Observation (temperature only)	12
(temperature/pressure)	2
Non-Operational	1

FACILITIES

STEAM GENERATOR(S): two - 53 GJ/hr

ARTIFICIAL LIFT METHODS: Standard Pump Jack

TREATER TYPE: 8' x 30' Cenatco

STORAGE FACILITIES: Oil 3 x 499 m³

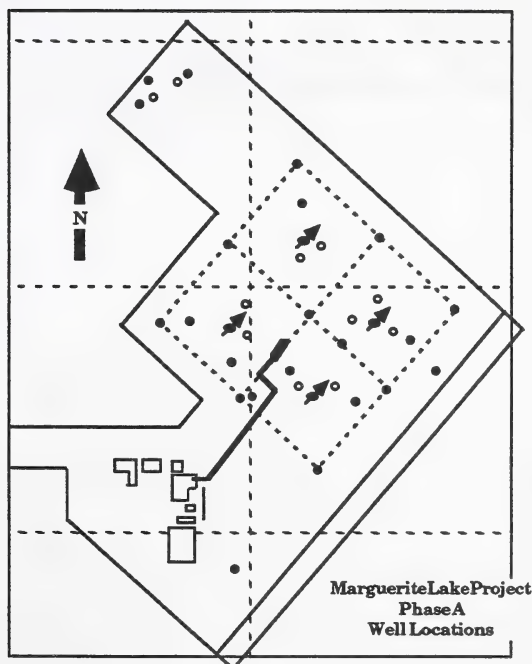
Water - 800 m³

TRANSPORT: Truck

RESERVOIR

Geological Horizon:	Clearwater
Depth to Top of Formation:	440 m.KB
Reservoir Thickness:	
net:	23 m
gross:	35.4 m
Original Temperature:	16°C
Original Pressure:	2800 kPa
Average Horizontal Permeability:	1150 md
Average Porosity:	31%
Average Water Saturation S _w	35%
Average Oil Saturation S _o	65% pore volume
Oil Viscosity at Reservoir Temp.	100,000 mPa.s
Oil Gravity at Reservoir Temp.	993 Kg/m ³
Source:	Project Operator

COMMENTS: Combustion development continued at Wolf Lake.



Canadian Occidental Petroleum Ltd.

Manatokan

LOCATION

LSD 1/2 Section: 13 Township: 63 Range: 8 W4M

PARTNERS:

Westcoast Petroleum Ltd. (Override royalty)

PROCESS: Huff'n puff/steam drive

COST: Capital \$25 MM

START-UP: December 1985

TERMINATION: December 1990

DESCRIPTION

PILOT AREA: 48 ha (subsurface - pad drilling)

WELL PATTERN: 12 inverted 5-Spot patterns (4 ha spacing)

WELL SPACING: 2 ha

NO. OF WELLS:

Injection	32
Production	32
Observation	(+ 1 tentative) 1

Note: All wells are steamed then produced.

FACILITIES

STEAM GENERATOR(S): three - 52.76 GJ/hr steam generators

ARTIFICIAL LIFT METHODS: Slant hole conventional

TREATER TYPE: Heater treater and evaporator dehydrator (polishing unit)

STORAGE FACILITIES: four 63.5 m³ insulated tanks

TRANSPORT: Truck oil to Murphy Blackfoot truck terminal in Lloydminster area.

RESERVOIR

Geological Horizon:	Lower Grand Rapids Formation
Depth to Top of Formation:	370 m.KB

Reservoir Thickness:	
net:	12 m
gross:	22 m

Original Temperature:	20°C
-----------------------	------

Original Pressure:	3600 kPa
--------------------	----------

Average Horizontal Permeability:	1000 md
----------------------------------	---------

Average Porosity:	31%
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Average Water Saturation S_w	30%
--------------------------------	-----

Average Oil Saturation S_o	70% pore vol.
------------------------------	---------------

Oil Viscosity at Reservoir Temp.	90000 mPa.s
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Oil Gravity at Reservoir Temp.	993 Kg/m ³
--------------------------------	-----------------------

Source:	Pilot Operator
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COMMENTS: Suspended September 1988.
Project currently being abandoned.

Canadian Occidental Petroleum Ltd.

Morgan

LOCATION

LSD: 10 Section: 34 Township: 51 Range: 4 W4M

PARTNERS:

Canadian Occidental Petroleum Ltd. 100%

PROCESS: Fireflood; ran on cyclic steam, currently on primary.

COST: Capital - \$8.2 million

START-UP: February 1986

TERMINATION: February 1991

DESCRIPTION

PILOT AREA: 16 ha

WELL PATTERN: 4, 4 ha inverted 5-Spots

WELL SPACING: 2 ha

NO. OF WELLS:

Injection	0
Production	13
Observation	0

FACILITIES

STEAM GENERATOR(S): one - 0.44 GJ/hr steam generator for pre-heat

ARTIFICIAL LIFT METHODS: Hydraulic pumping units; progressive cavity

TREATER TYPE: HTI (electronic) and Colt (distillation) polishing unit

STORAGE FACILITIES: 13 tanks (1684 m³ total capacity)

TRANSPORT: Husky's Cold Lake Heavy Oil Pipeline (tie-in on site)

RESERVOIR

Geological Horizon: Lloydminster Formation
Depth to Top of Formation: 570 TVD m.KB

Reservoir Thickness:
net: 7 TVD m
gross: 11 TVD m

Original Temperature: 23°C

Original Pressure: 3200 kPa

Average Horizontal Permeability: 3000 md

Average Porosity: 28%

Average Water Saturation S_w 25%

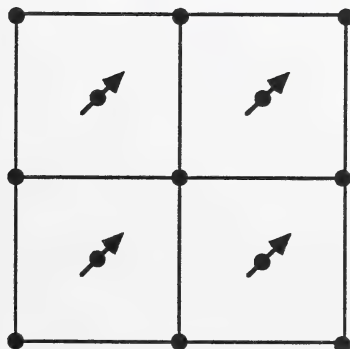
Average Oil Saturation S_o 75% pore vol.

Oil Viscosity at Reservoir Temp. 4600 mPa.s

Oil Gravity at Reservoir Temp. 988 Kg/m³

Primary Production Rates: 2.0 m³/well/day
Source: Pilot Operator

COMMENTS: Steam suspended July 1988. Lost pilot status in 1990. Currently operating on primary production mode.



Claude Beau Canada Petroleum Ltd.

Twining Rundle Pool

LOCATION

LSD: 16 Section: 16 Township: 32 Range:24 W4M

PARTNERS:

Claude Beau Canada Petroleum Ltd.	70%
AOSTRA	30%

PROJECT: Drilling a horizontal well in the Rundle formation.

START-UP: September 15, 1991

TERMINATION: October 21, 1991

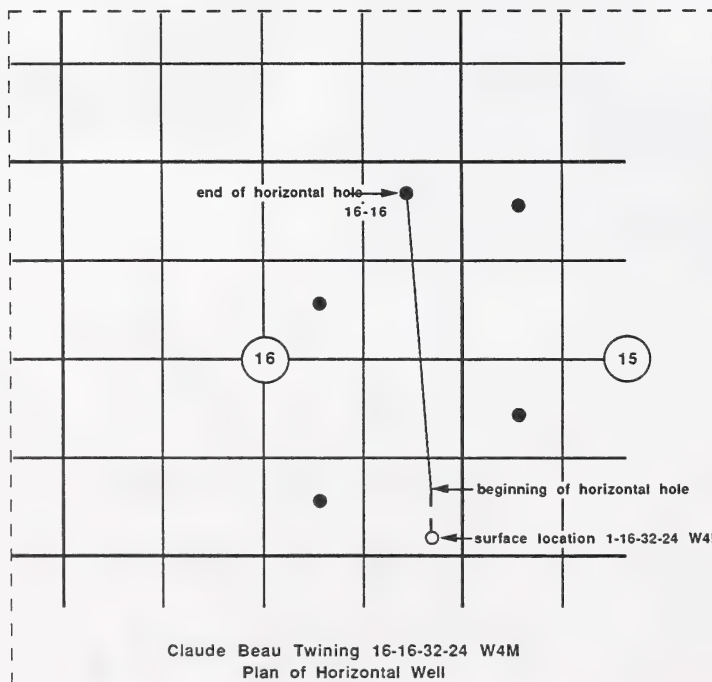
DESCRIPTION

Drilling a well at surface location 1-16-32-24 W4M with a 1200 m horizontal section in the Rundle formation targeted for 16-16-32-24 W4M.

NO. OF WELLS: one

RESERVOIR:

Formation	Rundle
Depth to Top of Formation	1650 m
Reservoir Thickness	
net	12.5 m
gross	40 m
Original Reservoir Temperature	61°C
Original Reservoir Pressure	11410 kPa
Horizontal Permeability	low, but fractures are present
Average Porosity	6.3%
Average Water Saturation Sw	29%
Average Oil Saturation So	71%
Oil Viscosity at Reservoir Temp.	1.6 mPa.s
Oil Gravity at Reservoir Temp	876 Kg/m3
Average Initial Production Rate of Vertical Wells	4 m3/well/d
Source	Pilot Operator



CS Resources

Pelican

LOCATION

Section: 3-17 Township: 81 Range: 22 W4M

PARTNERS:

C.S. Resources Ltd
Devran Petroleum Ltd.

PROCESS: Primary fireflood, cyclic steam

START-UP: 1980 Primary, 1981-1986 Fireflood,
1983/1989 Cyclic Steaming

TERMINATION: May 1989

DESCRIPTION

PILOT AREA: Post-Combustion Primary, Water
and Steam Flood

WELL PATTERN: 9 Inverted 30 Acre 17 Spot
Patterns

OUTER PILOT AREA: Primary, Cyclic Steaming,
Horizontal wells

WELL PATTERN: Single Wells

WELL SPACING: See Above

NO. OF WELLS:

Vertical Wells	13
Horizontal Wells	17

FACILITIES

ARTIFICIAL LIFT METHODS: Lufkin, Griffin, Corod,
EMIP

TREATER TYPE: Atmospheric

STORAGE FACILITIES:

Single Wells - 750 BBI Tanks

Others - Group/Test Tanks

TRANSPORT:

Pilot - Underground to treating facilities

Outer Area - Tank Trucks

RESERVOIR

Geological Horizon: Wabiskaw - McMurray

Depth to Top of Formation: 400 m.KB

Reservoir Thickness:
net: 3.5-6.5 m

gross: 6.5 m

Original Temperature: 18°C

Original Pressure: 2375 kPa

Average Horizontal Permeability: 1000 md

Average Porosity: 26%

Average Water Saturation S_w 30%

Average Oil Saturation S_o 70% pore volume

Oil Viscosity at Reservoir Temp. 800-1200 mPa.s

Oil Gravity at Reservoir Temp. 973 Kg/m³

Primary Production Rates: 2.8 m³/well/day
Source: Pilot Operator

COMMENTS: In Mid-1989, Gulf Canada Resources transferred its 100% ownership in the "Pelican project to C.S. Resources of Calgary. Prior to the transfer, Gulf abandoned the fireflood project and the majority of the single well installations. C.S. Resources retained 12 single wells and the 8 horizontal wells as well as the treating facilities. C.S. Resources have continued to operate the retained facilities in primary production mode only

Esso Resources Canada Ltd.

Leduc

LOCATION

LSD: 8 Section: 17 Township: 50 Range: 26 W4M

PARTNERS:

Esso Resources Canada Ltd.
Leduc Woodbend D-2 Unit

PROCESS: Hydro carbon miscible flood
(propane) following brine pre-flush

START-UP: September 1985

TERMINATION: May 1988

DESCRIPTION

WELL SPACING: See plot plan

NO. OF WELLS:

Injection	1
Production	1
Observation	1

FACILITIES

ARTIFICIAL LIFT METHODS: Rod Pump

TREATER TYPE: 3 phase separator

STORAGE FACILITIES: Brine & Propane tanks for
Injection

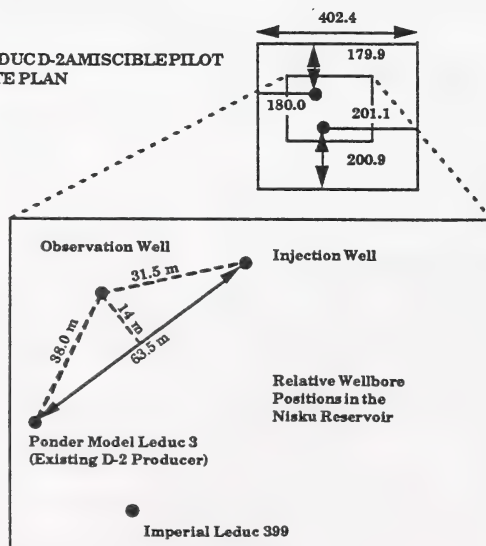
TRANSPORT: Injected fluids are trucked.
Produced fluids are transported through existing
flowlines.

RESERVOIR

Geological Horizon:	Nisku
Depth to Top of Formation:	1550 m.KB
Reservoir Thickness:	
gross:	45 m
Original Temperature:	63°C
Original Pressure:	12300 kPa
Average Horizontal Permeability:	10 md
Average Porosity:	3.7%
Average Water Saturation S_w	26%
Average Oil Saturation S_o	34% pore vol.
Oil Viscosity at Reservoir Temp.	0.6 mPa.s
Oil Gravity at Reservoir Temp.	730 Kg/m ³
Primary Production Rates:	30 m ³ /well/day
Source:	Pilot Operator

COMMENTS: The pilot is located at 8-17-50-26 W4M and consists of an injector producer pair. One observation well was drilled in October, 1987 and a sponge core taken. The oil saturation was measured by interwell tracer, sponge core and single well tracer. All three methods yielded the same answer.

LEDUC D-2 AMISCIBLE PILOT
SITE PLAN



Excel Energy Inc.

Ardmore

LOCATION

LSD: 11,12,13,14 Section: 20 Township: 62
Range: 3 W4M

PARTNERS:

Excel Energy Inc.	65%
Koch Exploration Ltd.	35%

PROCESS: Steam Stimulation/Steam Drive

COST: Operating: \$45,000/month

START-UP: September 1, 1975

TERMINATION: July 1, 1989

DESCRIPTION

PILOT AREA: 32.4 ha

WELL PATTERN: 5-Spot pattern

WELL SPACING: 1.02 ha and 2.04 ha/well

NO. OF WELLS:

Injection/Production	18
Water disposal	1

FACILITIES

STEAM GENERATOR(S): one - 26 GJ/hr steam generator

ARTIFICIAL LIFT METHODS: Conventional Pump
Jacks

TREATER TYPE: Atmospheric

STORAGE FACILITIES: Tanks

TRANSPORT: Truck

RESERVOIR

Geological Horizon:	Clearwater
Depth to Top of Formation:	375 m.KB

Reservoir Thickness:

net:	15 m
------	------

gross:	40 m
--------	------

Original Temperature:	15°C
-----------------------	------

Original Pressure:	2000 kPa
--------------------	----------

Average Horizontal Permeability:	1500 md
----------------------------------	---------

Average Porosity:	30%
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Average Water Saturation S_w	30%
--------------------------------	-----

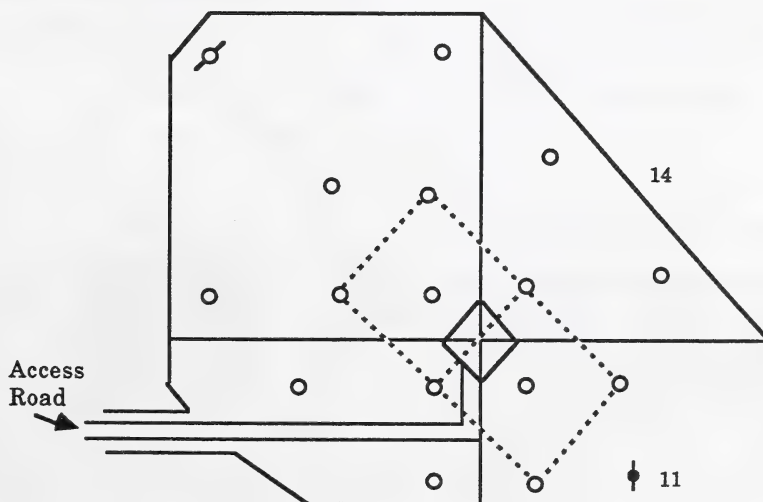
Average Oil Saturation S_o	70% pore volume
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Oil Viscosity at Reservoir Temp.	500,000 mPa.s
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Oil Gravity at Reservoir Temp.	1,000 Kg/m ³
--------------------------------	-------------------------

Source:	Pilot Operator
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COMMENTS: Project abandoned. Site restoration in progress. January 27, 1992



Husky Oil Operations Ltd.

Kearl Lake

LOCATION

Sections: 9,10,15 & 16 Township: 95 Range: 7
W4M.

PARTNERS:

*Husky Oil Operations Ltd.	38.25%
Esso Resources Canada Limited	36.75%
AOSTRA	25.00%

PROCESS: Modified Steam Drive

COST: Capital - \$55,000,000
Operating - \$79,000,000

START-UP: 1981

TERMINATION: Pilot operations were terminated in April 1991. All pilot wells have been abandoned.

DESCRIPTION

PILOT AREA: "A" Pattern 6.4 ha; "B" Pattern 3.24 ha

WELL PATTERN: "A" Pattern - seven-spot
"B" Pattern - five-spot
and nine spot

WELL SPACING: "A" Pattern 0.71 ha; B11 Pattern 0.27 ha; B18 & B19 Patterns 0.54 ha.

NO. OF WELLS:

	"A" Pattern	"B" Pattern
Injection (steam)	7 (7 suspended)	4
Production	6 (3 suspended)	12
		(1 suspended)
Observation	9 (3 suspended)	14

FACILITIES

STEAM GENERATORS: Three 53 GJ/hr steam generators

ARTIFICIAL LIFT METHODS: Conventional rod insert pumps.

TREATER TYPE: Field separators and pressure treaters at central facility.

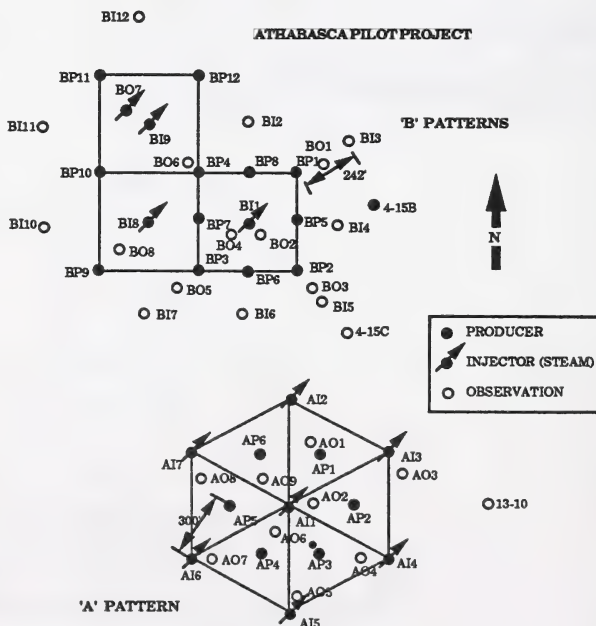
STORAGE FACILITIES: Heated tanks.

TRANSPORT: Trucks.

RESERVOIR

Producing Formation:	McMurray
Depth to Top of Formation:	150 m.KB
Reservoir Thickness:	
net:	40 m
gross:	75 m
Original Temperature:	10°C
Original Pressure:	800 kPa
Average Horizontal Permeability:	2000-6000 md
Average Porosity:	32%
Average Water Saturation S_w	24%
Average Oil Saturation S_o	76%
Oil Viscosity at Reservoir Temp.	2.0×10^6 mPa.s
Oil Gravity at Reservoir Temp.	1014 Kg/m ³
Source:	Pilot Operator

COMMENTS: Husky Oil Operations Ltd. acts as agent for Canterra Energy Ltd.



Mazzei Oil & Gas Ltd.

Frog Lake

LOCATION

Section: 15 Township: 56 Range: 3 W4M

TRANSPORT: Truck oil to Murphy Blackfoot or BP Chauvin

PARTNERS:

Mazzei Oil & Gas Ltd. 50%
AOSTRA 50%

RESERVOIR

Geological Horizon: G.P. and Sparky Zones
Depth to Top of Formation: 450-454 m.KB
Reservoir Thickness:
 net: 3 m
 gross: 5 m
Original Temperature: 25°C
Original Pressure: 3500 kPa
Average Horizontal Permeability: 4000 md
Average Porosity: 37%
Average Water Saturation S_w : 20%
Average Oil Saturation S_o : 80% pore volume
Oil Viscosity at Reservoir Temp. 2500 mPa.s
Oil Gravity at Reservoir Temp. 978 Kg/m³
Primary Production Rates: 3-7 m³/well/day
Source: Pilot Operator & AOSTRA

PROCESS: Compare single well steam stimulation vs. electromagnetic oil recovery stimulation

COST: \$1 Million

START-UP: January 1988

TERMINATION: July 1991

DESCRIPTION

Compare electromagnetic oil recovery process vs. single well Huff and Puff Steam Stimulation

PILOT AREA: Frog Lake

WELL SPACING: 40 acre

NO. OF WELLS: 4

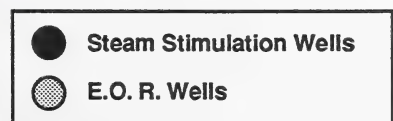
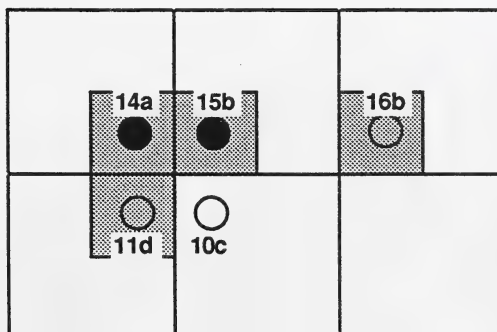
FACILITIES

STEAM GENERATOR(S): Contract out 1 - 22 mill steam generator

ARTIFICIAL LIFT METHODS: Tubing Pump

STORAGE FACILITIES: Four 750 bbl tanks

COMMENTS: First cycle of steam averaged 1500 m³ slug. Second cycles averaged 2500 m³ slug. All pilot wells are shut in.



Mobil Oil Canada, Ltd.

Kitscoty

LOCATION

Section: 7, 18, 12, 13 & 14 Township:51
Range: 2 W4M

PARTNERS:

Mobil Oil Canada, Ltd.
Norcen Energy Resources Ltd.
Home Oil Company Ltd.

PROCESS: Thermal drive with water slug.

START-UP: September 1975

TERMINATION: December 1988

DESCRIPTION

PILOT AREA: 420.9 ha

WELL PATTERN: Inverted 7-Spots

WELL SPACING: 4.05 ha

NO. OF WELLS:

Injection	7
Production	84
Observation	2

FACILITIES

STEAM GENERATOR(S): one air compressor 90.6 x
10³ m³/d @ 6.895 MPa

ARTIFICIAL LIFT METHODS: Standard Pump Jacks
with some Griffin downhole pumps.

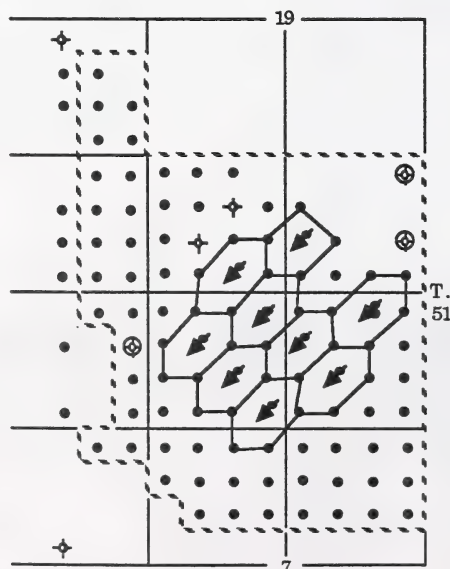
TREATER TYPE: Pressure Treater

STORAGE FACILITIES: Lease tanks and central
treating receiving tanks.

TRANSPORT: Husky Pipeline

RESERVOIR

Geological Horizon:	Sparky Sand
Depth to Top of Formation:	548 m.KB
Reservoir Thickness:	
net:	5 m
Original Temperature:	21°C
Original Pressure:	3450 kPa
Average Horizontal Permeability:	2000 md
Average Porosity:	34%
Average Water Saturation S_w	15%
Average Oil Saturation S_o	85% pore volume
Oil Viscosity at Reservoir Temp.	15,000- 40,000mPa.s
Oil Gravity at Reservoir Temp.	985 Kg/m ³
Primary Production Rates:	1-2 m ³ /well/day
Source:	Pilot Operator



Mobil Oil Canada, Ltd.

Wolf Lake

LOCATION

Section: 5, 6, 7, 8 Township: 64 Range: 6 W4M
Also: 21, 27-64-6, 12-64-7, 31, 32-63-6 and 36-63-7

PARTNERS:

Mobil Oil Canada, Ltd. 100%

PROCESS: Cyclic Steam Stimulation

START-UP: May 1982; Several tests added

TERMINATION: March 31, 1991

DESCRIPTION

PILOT AREA: Widely spaced wells.

WELL PATTERN: Individual well steam stimulations

NO. OF WELLS:

Injection/Production 15

Observation 1

(Nine wells currently suspended.)

FACILITIES

STEAM GENERATOR(S): one portable 26 GJ/hr

ARTIFICIAL LIFT METHODS: Conventional tubing pumps.

TREATER TYPE: Produced to wellhead tanks and trucked to recently completed on-site treating and water disposal facilities employing a pressure treater. Clean oil is trucked to the Husky sales terminal at Tucker

TRANSPORT: Trucked

RESERVOIR

Geological Horizon: Upper & Lower Grand Rapids

Depth to Top of Formation: UGR 310-350 m.KB

LGR 340-380 m.KB

Reservoir Thickness:

net: UGR 0-10 m

LGR 10-30 m

gross: UGR 20-60 m

LGR 60-80 m

Original Temperature: 15°C

Original Pressure: 3200 kPa

Average Horizontal Permeability: 1000-4000 md

Average Porosity: 35%

Average Water Saturation S_w 38%

Average Oil Saturation S_o 62% pore volume

Oil Viscosity

at Reservoir Temp. 20,000-100,000 mPa.s

Oil Gravity at Reservoir Temp. 1000-986 Kg/m³

(10-12°API)

Source: Pilot Operator

Mobil Oil Canada, Ltd.

Wolf Lake Extension

LOCATION

LSD: 11 Section: 17 Township: 64 Range: 6 W4M

PARTNERS:

Mobil Oil Canada, Ltd. 100%

PROCESS: Horizontal well-steam stimulated

START-UP: June 15, 1989

TERMINATION: June 1991

DESCRIPTION

Horizontal well - steam stimulated - with 3 vertical temperature observation wells.

PILOT AREA: ~3 ha

WELL PATTERN: single horizontal well - 300 m

NO. OF WELLS: 4-1 horizontal, 3 vertical

FACILITIES

STEAM GENERATOR(S): 1 - 26 GJ/hr

ARTIFICIAL LIFT METHODS: steam circulation/
beam pump

TREATER TYPE: Atmospheric gravity segregation on-site.

STORAGE FACILITIES: six 120 m³ tanks

TRANSPORT: Trucked to Iron River Facility for treating prior to trucking to Husky Tucker Lake terminal.

RESERVOIR

Geological Horizon: Lower Grand Rapids - G.P.

Depth to Top of Formation: 375 m

Reservoir Thickness:

net: 12 m

gross: 17 m

Original Temperature: 15°C

Original Pressure: 3000 kPa

Average Horizontal Permeability: 3 Darcies

Average Porosity: 35%

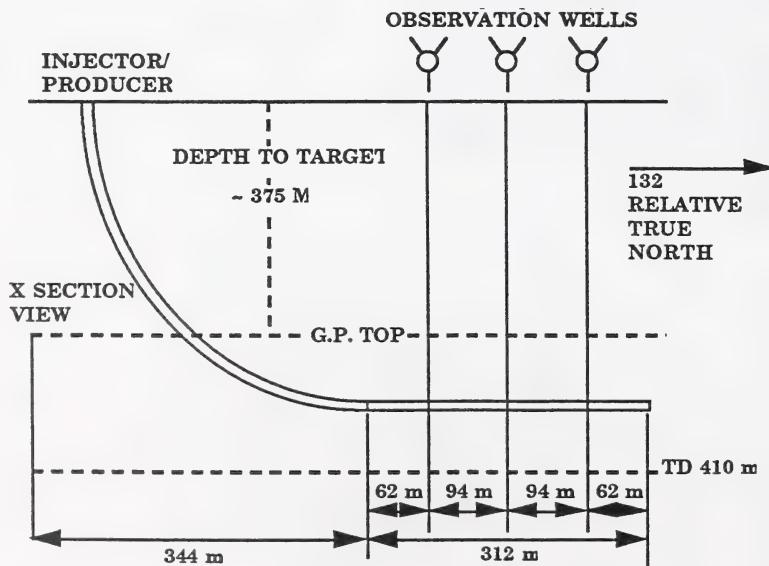
Average Water Saturation S_w : 25%

Average Oil Saturation S_o : 75% pore volume

Oil Viscosity at Reservoir Temp. 100,000 mPa.s

Oil Gravity at Reservoir Temp. 997 Kg/m³

Source: Pilot Operator



Murphy Oil Company Ltd.

Lindbergh

LOCATION

LSD: 6 Section: 13 Township: 58 Range: 5 W4M

PARTNERS:

Murphy Oil Company Ltd. 100%

PROCESS: Cyclic Steam Stimulation

COST: Capital - \$7 MM
Operating - \$2.5 MM/Yr.

START-UP: 1974

TERMINATION: December 31, 1990

DESCRIPTION

PILOT AREA: 20.23 ha

WELL PATTERN: Elongated 7-Spot

WELL SPACING: 2.02 ha

NO. OF WELLS:

Injection/Production 16

Observation 0

FACILITIES

STEAM GENERATOR(S): one - 21 GJ/hr steam generator and one - 53 GJ/hr steam generator

ARTIFICIAL LIFT METHODS: Insert Pumps

TREATER TYPE: Murphy Evaporation Dehydrator

STORAGE FACILITIES: Tied into commercial expansion.

TRANSPORT: Truck

RESERVOIR

Geological Horizon: Lower Grand Rapids

Depth to Top of Formation: 510 m.KB

Reservoir Thickness:
net: 20 m

gross: 20 m

Original Temperature: 21°C

Original Pressure: 2700 kPa

Average Horizontal Permeability: 2500 md

Average Porosity: 33%

Average Water Saturation S_w 18%

Average Oil Saturation S_o 82% pore volume

Oil Viscosity at Reservoir Temp. 100,000 mPa.s

Oil Gravity at Reservoir Temp. 990 Kg/m³

Source: Pilot Operator

COMMENTS: Pilot project approval expired on December 31, 1990. Not operating. Experimental pilot now included into commercial project Approval #6410.

Murphy Oil Company Ltd.

Morgan

LOCATION

LSD: 11 Section: 2 Township: 52 Range: 4 W4M

PARTNERS:

Murphy Oil Company Ltd. 100%

PROCESS: Cyclic Steam Stimulation

COST: Operating - \$0.2 MM/Yr.

START-UP: September 1985

TERMINATION: September 30, 1988

DESCRIPTION

PILOT AREA: 4 ha

WELL PATTERN: Single Well

NO. OF WELLS:

Injection	1
Production	1
Observation	0

FACILITIES

STEAM GENERATOR(S): Portable Rental

ARTIFICIAL LIFT METHODS: Insert Pump

TREATER TYPE: None

STORAGE FACILITIES: Two 120 m³ tanks

TRANSPORT: Truck

RESERVOIR

Geological Horizon: Lloydminster A

Depth to Top of Formation: 574 m.KB

Reservoir Thickness:

net: 13 m

gross: 13 m

Original Temperature: 21°C

Original Pressure: 3450 kPa

Average Horizontal Permeability: 1800 md

Average Porosity: 33%

Average Water Saturation S_w 30%

Average Oil Saturation S_o 70% pore volume

Oil Viscosity at Reservoir Temp. 14,500 mPa.s

Oil Gravity at Reservoir Temp. 994 Kg/m³

Primary Production Rates: 1.75 m³/well/day

Source: Pilot Operator

COMMENTS: Pilot approval expired on September 30, 1988. Not operating.

Norcen Energy Resources Ltd.

Lindbergh II

LOCATION

LSD: 1,2,7,8 Section: 13 Township: 55 Range: 6
W4M

PARTNERS:

Norcen Energy Resources Ltd. 100%

PROCESS: Cyclic Steam Stimulation

COST: Capital -\$7,500,000

START-UP: October 1984

TERMINATION: October 24, 1991

DESCRIPTION

PILOT AREA: 64.6 ha

WELL PATTERN: 9-Spot

WELL SPACING: 4.05 ha

NO. OF WELLS:

Injection/Production	16
Observation	0

FACILITIES

STEAM GENERATOR(S): one - 52.75 GJ/hr steam generator

ARTIFICIAL LIFT METHODS: Conventional Tubing Pump and Pump Jack System

TREATER TYPE: H.T.I. Pump Jack System

STORAGE FACILITIES: two - 150 m³ tanks

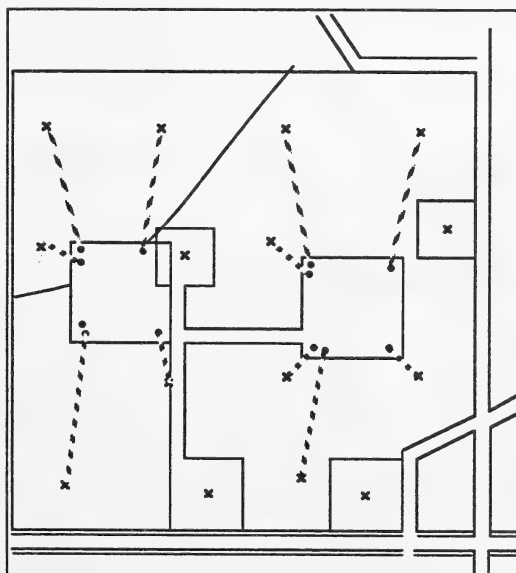
TRANSPORT: Pipeline

RESERVOIR

Geological Horizon:	Cummings
Depth to Top of Formation:	600 m.KB
Reservoir Thickness:	
net:	13.12 m
gross:	15 m
Original Temperature:	24°C
Original Pressure:	3900 kPa
Average Horizontal Permeability:	2838 md
Average Porosity:	25.2%
Average Water Saturation S_w	19.9%
Average Oil Saturation S_o	80.1% pore volume
Oil Viscosity at Reservoir Temp.	9800 mPa.s
Oil Gravity at Reservoir Temp.	986 Kg/m ³
Primary Production Rates:	6.0 m ³ /well/day
Source	Pilot Operator

COMMENTS:

Commissioning of steam generator in May, 1987 with steam injection commenced in June 1987. 13 wells steamed to date.



Norcen Energy Resources Ltd.

Lindbergh III

LOCATION

LSD: 11,12,13,14 Section: 13 Township: 55
Range: 6 W4M

PARTNERS:

Norcen Energy Resources Ltd. 100%

PROCESS: Modified Steam Drive

COST: Capital -\$6,000,000

START-UP: December 1985

TERMINATION: May 31, 1991

DESCRIPTION

PILOT AREA: 64.6 ha

WELL PATTERN: Inverted 9-Spot with Production Control Wells

WELL SPACING: 4.02 ha/well

NO. OF WELLS:

Injection	1
Production	15
Observation	2

FACILITIES

STEAM GENERATOR(S): one - 23.2 GJ/hr steam generator

ARTIFICIAL LIFT METHODS: Conventional tubing and pump and pump jack system and progressive cavity pump system.

TREATER TYPE: H.T.I. Pump Jack System

STORAGE FACILITIES: 119 m³ tanks

TRANSPORT: Trucked to Westmin cleaning plant and shipped via Husky pipeline to Lloydminster.

RESERVOIR

Geological Horizon: Cummings

Depth to Top of Formation: 600 m.KB

Reservoir Thickness:
net: 7.31 m

gross: 7.31 m

Original Temperature: 24°C

Original Pressure: 3200 kPa

Average Horizontal Permeability: 3230 md

Average Porosity: 24.7%

Average Water Saturation S_w : 20.9%

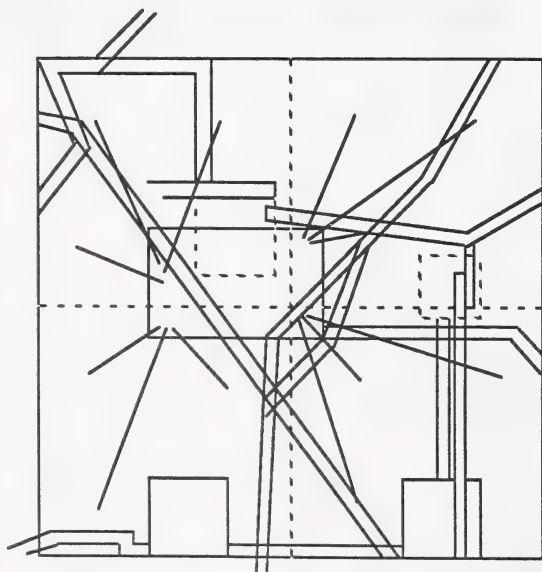
Average Oil Saturation S_o : 79.1% pore volume

Oil Viscosity at Reservoir Temp.: 9750 mPa.s

Oil Gravity at Reservoir Temp.: 986 Kg/m³

Primary Production Rates: 6.0 m³/well/day
Source: Pilot Operator

COMMENTS: Steam injection commenced in May, 1986 and operation continuing.



PanCanadian Petroleum Ltd.

Lindbergh

LOCATION

Section: 07 Township: 55 Range: 5 W4M

Section: 03 Township: 56 Range: 6 W4M

PARTNERS:

PanCanadian Petroleum Ltd. 100%

PROCESS: Cyclic Steam Stimulation

COST: Capital - \$60,000/well (est.)

Operating - \$150,000/well/yr.

START-UP: September 1983 (as per Approval No. 3886)

TERMINATION: 1990

DESCRIPTION

WELL SPACING: 4 ha - 16 ha

NO. OF WELLS:

Injection/Production

18

FACILITIES

STEAM GENERATOR(S): one - 25 MMBtu

ARTIFICIAL LIFT METHODS: Standard steam and heavy oil sucker rod pump/screw pump.

STORAGE FACILITIES: Standard stock tanks

TRANSPORT: Truck, LACT Unit

RESERVOIR

Geological Horizon: Cummings B & C

Depth to Top of Formation: 580 m.KB

Reservoir Thickness:

net: 9 (Sec. 7) 12 (Sec. 3) m

gross: 12 (Sec. 7) 18 (Sec. 3) m

Original Temperature: 24°C

Original Pressure: 4400 kPa

Average Horizontal Permeability: 1000 md

Average Porosity: 30%

Average Water Saturation S_w 20%

Average Oil Saturation S_o 80% pore volume

Oil Viscosity at Reservoir Temp. 3000 mPa.s

Oil Gravity at Reservoir Temp. 986 Kg/m³

Primary Prod. Rates: 2 (Sec. 7) m³/well/day

6 (Sec. 3) m³/well/day

Source: Pilot Operator

PanCanadian Petroleum Ltd.

Lindbergh - Elk Point

LOCATION

LSD: 11 Section: 03 Township: 56 Range: 6 W4M
Lindbergh

PARTNERS:

PanCanadian Petroleum Ltd. 100%

PROCESS: Steamflood Pilot

COST: Capital - \$520 M
Operating - \$1600/day

START-UP: April 1990 (as per Approval #6099)

TERMINATION: 1991

DESCRIPTION

Steamflood Pilot Project commenced injection in April 1990.

PILOT AREA: 4 ha

WELL PATTERN: inverted 5-spot

WELL SPACING: 4 ha

NO. OF WELLS:

injection	1
production	4

FACILITIES

STEAM GENERATOR(S): one - 25 MMBtu

ARTIFICIAL LIFT METHODS: Screw pump/standard steam and heavy oil sucker rod/jet pump.

STORAGE FACILITIES: Standard stock tanks

TRANSPORT: Truck, LACT

RESERVOIR

Geological Horizon: Cummings B & C

Depth to Top of Formation: 603 m.KB

Reservoir Thickness:

net:	13 m
gross:	18 m

Original Temperature: 24°C

Original Pressure: 4400 kPa

Average Horizontal Permeability: 1000 md

Average Porosity: 30%

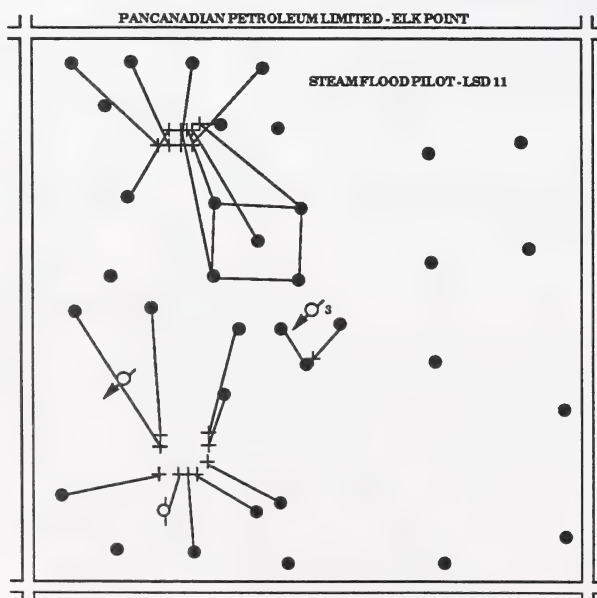
Average Water Saturation S_w : 22%

Average Oil Saturation S_o : 78% pore volume

Oil Viscosity at Reservoir Temp. 3000 mPa.s

Oil Gravity at Reservoir Temp. 985 Kg/m³

Primary Prod. Rates: 6 m³/well/day
Source: Pilot Operator



Petro-Canada Resources

Coal-Bed Methane

LOCATION

LSD Section:21 Township: 57 Range: 21 W4M

PARTNERS:

Petro Canada

PROCESS: Coal Bed Methane Evaluation

START-UP: April 6, 1991

TERMINATION: April 9, 1991

DESCRIPTION

PILOT AREA: 640 acres

WELL PATTERN: single well

NO. OF WELLS: one

SOURCE: Pilot Operator

COMMENTS: Shut-in due to excessive water production; project indefinitely suspended.

Petro-Canada Resources

Hangingsstone I

LOCATION

LSD: 13 Section: 27 Township: 84 Range: 11
W4M

PARTNERS:

Petro-Canada Resources	25%
Canadian Occidental Petroleum Ltd.	25%
Esso Resources Canada Ltd.	25%
Japan Canada Oil Sands	25%

PROCESS: Cyclic Steam Stimulation

START-UP: February 1, 1985

TERMINATION: January, 1988

DESCRIPTION

PILOT AREA: Single Well Test

FACILITIES

STEAM GENERATOR(S): one - 26 GJ/hr portable
steam generator

ARTIFICIAL LIFT METHODS: Standard Pump Jack

TREATER TYPE: Atmospheric Treating Tank

STORAGE FACILITIES: Tank Farm on Site

TRANSPORT: Truck

RESERVOIR

Geological Horizon:	McMurray
Depth to Top of Formation:	261 m.KB
Reservoir Thickness:	
net:	43 m
gross:	51 m
Original Temperature:	15°C
Original Pressure:	2200 kPa
Average Horizontal Permeability:	1350 md
Average Porosity:	32%
Average Water Saturation S_w	17%
Average Oil Saturation S_o	83% pore volume
Oil Viscosity at Reservoir Temp.	1,000,000 mPa.s
Oil Gravity at Reservoir Temp.	1008 Kg/m ³
Source:	Pilot Operator

Petro-Canada Resources

Hangingsstone II

LOCATION

LSD: 16 Section: 27 Township: 84 Range: 11
W4M

PARTNERS:

Petro-Canada Resources	25%
Canadian Occidental Petroleum Ltd.	25%
Esso Resources Canada Ltd.	25%
Japan Canada Oil Sands	25%

PROCESS: Cyclic Steam Stimulation

START-UP: October 1986

TERMINATION: March, 1990

DESCRIPTION

PILOT AREA: Single Well Test

FACILITIES

STEAM GENERATOR(S): one - 26 GJ/hr portable
steam generator

ARTIFICIAL LIFT METHODS: Standard Pump Jack

TREATER TYPE: Atmospheric Treating Tank

STORAGE FACILITIES: Tank Farm on Site

TRANSPORT: Truck

RESERVOIR

Geological Horizon:	McMurray
Depth to Top of Formation:	261 m.KB
Reservoir Thickness:	
net:	26 m
gross:	51 m
Original Temperature:	15°C
Original Pressure:	2200 kPa
Average Horizontal Permeability:	1350 md
Average Porosity:	32%
Average Water Saturation S_w	17%
Average Oil Saturation S_o	83% pore volume
Oil Viscosity at Reservoir Temp.	1,000,000 mPa.s
Oil Gravity at Reservoir Temp.	1008 Kg/m ³
Source	Pilot Operator

Petro-Canada Resources

Hangingsstone III

LOCATION

LSD: 4 Section: 35 Township: 84 Range: 11 W4M

PARTNERS:

Petro-Canada Resources	25%
Canadian Occidental Petroleum Ltd.	25%
Esso Resources Canada Ltd.	25%
Japan Canada Oil Sands	25%

PROCESS: Cyclic Steam Stimulation

START-UP: January 1987

TERMINATION: December 1989

DESCRIPTION

PILOT AREA: Single Well Test

FACILITIES

STEAM GENERATOR(S): one - 26 GJ/hr portable steam generator

ARTIFICIAL LIFT METHODS: Standard Pump Jack

TREATER TYPE: Atmospheric Treating Tank

STORAGE FACILITIES: Tank Farm on Site

TRANSPORT: Truck

RESERVOIR

Geological Horizon:	McMurray
Depth to Top of Formation:	263 m.KB
Reservoir Thickness:	
net:	17 m
gross:	35 m
Original Temperature:	15°C
Original Pressure:	2200 kPa
Average Horizontal Permeability:	1350 md
Average Porosity:	32%
Average Water Saturation S_w	15%
Average Oil Saturation S_o	85% pore volume
Oil Viscosity at Reservoir Temp.	1,000,000 mPa.s
Oil Gravity at Reservoir Temp.	1008 Kg/m ³
Source:	Pilot Operator

Petro-Canada Resources

Provost Dina

LOCATION

LSD: 5 Section:10 Township:40 Range: 3 W4M

PARTNERS:

Petro Canada Resources 100%

PROCESS: Water control with polyacrylamide

COST: \$27,000

START-UP: September, 1990

TERMINATION: September 1990

DESCRIPTION

PILOT AREA: Single Well Test

FACILITIES

RESERVOIR

Geological Horizon: Provost Dina E2E

Depth to Top of Formation: 815 m.KB

Reservoir Thickness:

net: 12 m

gross: 12 m

Original Temperature: 29°C

Original Pressure: 5 430 kPa

Average Horizontal Permeability: 2 Darcies

Average Porosity: 28%

Average Water Saturation S_w 30%

Average Oil Saturation S_o 70% pore volume

Oil Viscosity at Reservoir Temp. 60 mPa.s

Oil Gravity at Reservoir Temp. .92 Kg/m³

Primary Prod. Rates: 3.5 oil m³/well/day

35 water m³/well/day

Source: Pilot Operator

COMMENTS: Polyacrylamide - weak gel. The treatment fractured out of zone while pumping, therefore the experiment was inconclusive.

Subsequent cement squeeze - 15 m³/d total fluids, at 50% water cut.

Petro-Canada Resources

Viking-Kinsella B

LOCATION

LSD: 2 Section: 24 Township: 48 Range: 9 W4M

PARTNERS:

Petro-Canada Resources	41%
PanCanadian Petroleum Ltd.	8%
Dome Petroleum Ltd.	1%
AOSTRA	50%

PROCESS: Oxygen In Situ Combustion

START-UP: January 1984

TERMINATION: December 1987

DESCRIPTION

PILOT AREA: 8 ha

WELL PATTERN: Inverted 5-Spot

WELL SPACING: 4 ha

NO. OF WELLS:

Injection	1
Production	4
Observation	2

FACILITIES

ARTIFICIAL LIFT METHODS: Insert Pumps






TREATER TYPE: Production to existing Kinsella B Battery

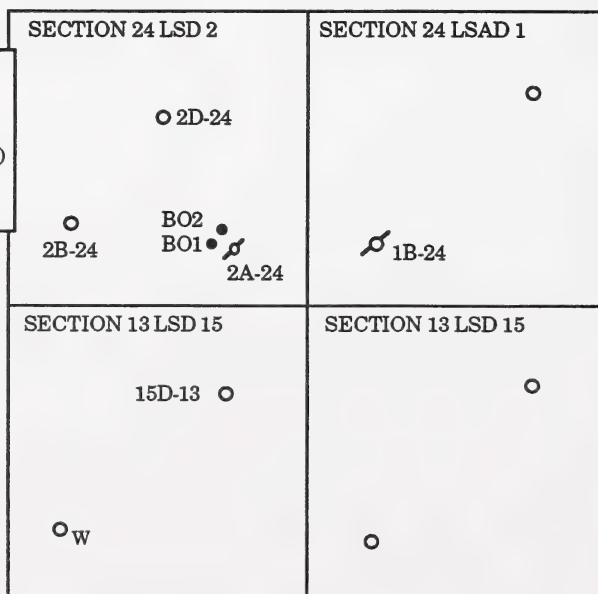
STORAGE FACILITIES: Production to existing Kinsella B Battery

TRANSPORT: Battery production shipped via pipeline.

RESERVOIR

Geological Horizon:	Sparky
Depth to Top of Formation:	652 m.KB
Reservoir Thickness:	
net:	4.0 m
gross:	5.0 m
Original Temperature:	28°C
Original Pressure:	5030 kPa
Average Horizontal Permeability:	200 md
Average Porosity:	30%
Average Water Saturation S_w	33%
Average Oil Saturation S_o	67% pore volume
Oil Viscosity at Reservoir Temp.	100 mPa.s
Oil Gravity at Reservoir Temp.	934 Kg/m ³
Source:	Pilot Operator

	AIR INJECTOR
	OBSERVATION WELL
	PRODUCER
	PRODUCER (Converted water injector)
	WATER INJECTOR



Signalta Resources Limited

Pembina - Lobstick

LOCATION

LSD: 16 Section: 1 Township: 51 Range: 7 W5M

PARTNERS:

Signalta Resources Limited

PROCESS: Foam-forming surfactant with lean gas injection.

START-UP: October 1986

TERMINATION: May 10, 1990

DESCRIPTION

PILOT AREA: 896 ha

WELL PATTERN: 64 ha

WELL SPACING: 64 ha

NO. OF WELLS:

Injection	1
Production	13
Observation	0

FACILITIES

ARTIFICIAL LIFT METHODS: Standard beam pumping unit. Two wells naturally flowing.

TREATER TYPE: Vertical (Installed 1989)

STORAGE FACILITIES: Tankage

TRANSPORT: Trucked to sales.

RESERVOIR

Geological Horizon: Ostracod

Depth to Top of Formation: 1725 m.KB

Reservoir Thickness:

net: 1.0 m

gross: 1.0 m

Original Temperature: 57°C

Original Pressure: 15,410 (abs) kPa

Average Horizontal Permeability: 70 md

Average Porosity: 12%

Average Water Saturation S_w 22%

Average Oil Saturation S_o 78% pore volume

Oil Viscosity at Reservoir Temp. 0.35 mPa.s

Oil Gravity at Reservoir Temp. 797 kg/m³

Primary Production Rates: 25 m³/well/day

Source: Pilot Operator

COMMENTS: Initial reservoir conditions.

Ulster Petroleum Ltd.

Retlaw

LOCATION

Section: 4, 9, 10, 15, 16, 21, 22, 27 & 28

Township: 12 Range: 18 W4M

PARTNERS:

Ulster Petroleum Ltd.	42.630578%
Atcor Ltd.	16.356042%
Canada North West Energy Ltd.	14.636474%
Acanthus Resources Ltd.	1.528604%
Bobby Burns Petroleum (1977) Ltd.	12.175636%
Scurry Rainbow Oil Limited	3.106713%
PanCanadian Petroleum Limited	6.452127%
Sceptre Ltd.	1.537419%
Bow Valley Industries Ltd.	1.537419%
Plaza Oil & Gas Ltd.	0.038988%

PROCESS: CO₂ Immiscible Flood and Water Flood (WAG)

START-UP: 1983 (Applied for Commercial Project Status)

TERMINATION: Experimental status terminated December 31, 1990

DESCRIPTION

PILOT AREA: 1133 ha

WELL PATTERN: Seven irregular patterns.

NO. OF WELLS:

Injection	7
Production	25
Observation	0

FACILITIES

Produced CO₂ and gas compressed and re-injected at battery facility.

ARTIFICIAL LIFT METHODS: Standard Pump Jacks

STORAGE FACILITIES: Standard oil battery facility.

RESERVOIR

Geological Horizon: Retlaw Mannville 'V' Pool
(Glauconite Sandstone)
(Mannville with hydrophilic clays)

Depth to Top of Formation: 1070 m.KB

Reservoir Thickness:
net: 2 - 2.5 m

Original Temperature: 35°C

Original Pressure: 11,376 kPa

Average Horizontal Permeability: 50 md

Average Porosity: 18%

Average Water Saturation - S_w 25%

Average Oil Saturation S_o 75% pore volume

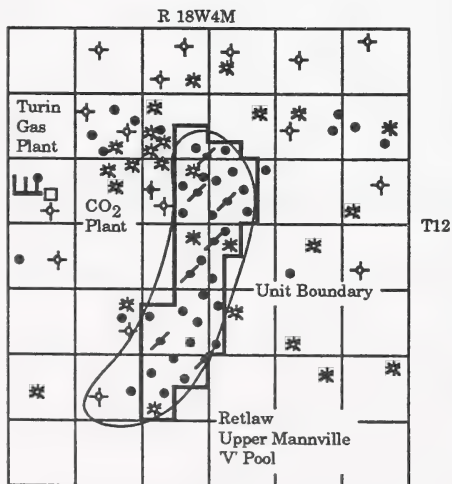
Oil Viscosity at Reservoir Temp. 11 mPa.s

Oil Gravity at Reservoir Temp. 916 Kg/m³

Primary Production Rates: 3-40 m³/well/day
Source: Pilot Operator

COMMENTS: AOSTRA is a consultive participant in this project.

All CO₂ injection wells converted to water injectors. Re-injection of produced solution gas and CO₂ started July 1990.



- OIL WELL
- * GAS WELL
- ↗ CO₂ INJECTION WELL
- ✕ DRY & ABANDONED

Vikor Resources Ltd.

Joffre - Phase I

LOCATION

Section: 15, 17, 20 & 22 Township: 38 Range: 25
W4M

PARTNERS:

AOSTRA	75%
Vikor Resources Ltd.	14%
Unit Partners	11%

PROCESS: CO₂ Miscible Flood (WAG) and
Mobility Control Testing

COST: Capital - \$7,500,000

START-UP: December 1982 - First CO₂ Injection
January 1984

TERMINATION: 1990*

DESCRIPTION

PILOT AREA: 129.5 ha (2 patterns)

WELL PATTERN: Two inverted 5-Spots plus two
offsetting water injection wells.

NO. OF WELLS:

Injection	(water) 2
	(CO ₂ + water) 2
Production	4
Observation	0

FACILITIES

CO₂ Injection: common with Phase II

ARTIFICIAL LIFT METHODS: Conventional;
subsurface pumps.

TREATER TYPE: 3-phase test and group separator
and 3 phase treater.

TRANSPORT: Crude sales through (LACT) to Gulf's
Pipeline

RESERVOIR

Geological Formation: Joffre Viking A Sand

Depth to Top of Formation: 1475 m.KB

Reservoir Thickness:

net: 3 m

gross: 4.5 m

Original Temperature: 56°C

Original Pressure: 7760 kPa

Average Horizontal Permeability: 500 md

Average Porosity: 13%

Initial Water Saturation: 30%

Oil Saturation After Waterflood: Appx. 40%

Oil Viscosity at Reservoir Temp. 1-2 mPa.s

Oil Gravity at Reservoir Temp. 813 kg/m³

Primary Production Rates: 7 m³/well/day

Source AOSTRA

COMMENTS: Facilities and
wells are now dedicated to
a commercial project in
accordance with ERCB
Approval #6636.

